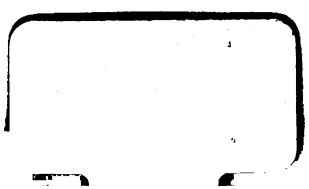

THE PREVENTION OF DISEASE IN ARMIES IN THE FIELD

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PREFACE

THIS little book has been written in the hope that what is, in the main, a record of sanitary experience in the field may possibly prove of some interest to those whose attention is particularly drawn to the physical well-being of the soldier on service.

I must apologize for the constant introduction of the personal element on the ground that I have endeavoured to formulate my own conclusions from my own experience, and to avoid the repetition of well-known matter. How far my conclusions are justified I must leave to the judgment of readers.

Certain of my statements have already appeared in the *British Medical Journal*, *Public Health*, and the *Journal of State Medicine*.

I may take this opportunity of making clear the fact that remarks relative to the Revolutionary Army of France refer solely to men whose mental attributes were the result of an altogether exceptional state of society. There is, I should add, no intention to convey any suggestion of a slur on a chivalrous and courageous people, whose military achievements have formed the wonder of the civilized world.

I have considered the term 'in the field' as bearing reference rather to the fighting force of an army than to the troops on the lines of communication or at the base, where conditions approximating to those of peace are likely to obtain, and sanitation, in consequence, carried out on generally accepted lines.

My best thanks are due to Captain C. Abbot Anderson, the Manchester Regiment, and Sergeant-Major A. Harwood, R.A.M.C., for their kindness in supplying me with photographs illustrative of matters of great practical importance; to Surgeon-Major S. Guise Moores, Scots Guards, for the trouble he has kindly taken in overlooking the proof sheets; to Major Cummins, R.A.M.C., for permission to reproduce a diagram of his well-known sterilizer; and to Major James Evelyn Pilcher of the United States Army, for his courtesy in obtaining for me a copy of the recent Annual Report of Surgeon-General Sternberg, a most valuable document, which I found of material assistance in my work.

R. C.

ALDERSHOT,
January 1, 1904.

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LIST OF ILLUSTRATIONS

ERRATA

Page 18, line 9, *for* 'bheestie skins' *read* 'mussacks.'

Page 78, line 19, *insert* 'as a general rule,' between the words 'it is,' and the word 'impossible.' The sentence should read 'It is, as a general rule, impossible at the front,' etc.

THE PREVENTION OF DISEASE IN ARMIES IN THE FIELD

CHAPTER I

INTRODUCTION

IT has been well stated that probability is the guide of life; in other words, experience tells us that a certain definite result is likely to follow certain definite conditions.

Lack of knowledge only precludes us from substituting certainty for probability in the above aphorism.

Cause and effect are immutable, so that if a complete comprehension of the workings of Nature were possible, we could, without fear of error, foretell the future for countless generations, beyond the course of life upon this earth, and into all eternity. The orderly sequence of events is no new discovery; it was well known to early philosophers, and is comprised in the principle which underlies the system followed by Bacon, Newton, Galileo, and others as illustrious. Its recognition is the foundation of true knowledge, and was therefore the direct cause of the early progress of science and civilization, until it was, for a time, obscured by the cloud of ignorance, fanaticism, and superstition, which hangs over the history of the Middle Ages.

During this period the search for natural knowledge received a check from which it has only partially recovered, even at the present day.

Phenomena of daily existence were explained as being directly caused by the agencies of spirits, either benign or malicious. A host of grotesque superstitions were confidently believed in, not only by the vulgar and illiterate, but by all classes of society. Alchemy and astrology were a fruitful source of livelihood for quacks and charlatans, while a pestilence, such as that known as the 'spotted death,' the result of grossly insanitary conditions, was regarded as being solely due to supernatural agencies. Owing to what may be called the intangible nature of disease, and the mystery which consequently surrounds its manifestations, the calling of medicine has encountered exceptional difficulties in freeing itself from the domain of superstition and imposture, although, no doubt, this difficulty has been accentuated by prejudice and reactionary legislation, apart altogether from the natural obstacles which stand in the way of successfully investigating problems of extreme complexity. Indeed, so far has medicine lagged behind in the march of civilization that, in the absence of sufficient knowledge, conclusions, even at the present day, are constantly arrived at concerning phenomena with which this science is connected, and lines of action consequently adopted, on the most faulty and insufficient of premises.

Of the above facts the history of military sanitation in most countries affords many examples. Experience in this connection was not formerly regarded as the natural guide for future action, though whether the

responsibility for this disregard of intelligent reasoning rests or not with members of the medical profession is not a matter which will be discussed here.

The fault in part lies with the military historian, who, in most cases, has concentrated the attention of the reader on political developments connected with war, on the nature of operations in the field, on the genius or otherwise of leaders, and on the fighting powers of subordinates, while information as to the physical condition of troops and the influence exerted in this connection on various campaigns has, with few exceptions, either been omitted or relegated to a position of minor importance. The medical histories of important wars will, of course, largely rectify this defect; but, as the information contained in this class of literature is conveyed in a technical manner, not readily understood by the general reader, and, in view of the fact already stated, viz., that it is generally absent from other historical works, including those used for official purposes, experience which might have proved of inestimable value has never been fairly brought home to the public mind, but has remained in the sole possession of the members of a profession not remarkable for influence in affairs of State. It would be too far from present purposes to dwell on a series of instances of the part played by the physical condition of armies on military operations, but there occurs nevertheless one such example, so striking in its attendant circumstances, and so stupendous in its results, that it might serve in itself as an illustration for all time of the fact that factors absolutely distinct from what may be considered as purely military considerations have deter-

mined the result of a struggle which destroyed a dynasty and altered for ever the course of the world's history.

On September 24, 1792, the troops of Prussia, under the personal leadership of their King,* marching to the rescue of Louis XVI., who, together with his Queen and family, was at this time a prisoner in Paris, came face to face with the troops of the newly-formed Republic on the heights of La Lune, near Valmy, in the Argonne District of France. On the one hand was an organized and disciplined army, vastly superior numerically to its opponents, and officered by trained soldiers, who numbered amongst themselves French noblemen who were not only bred to arms, but, what was probably of more value, possessed of a knowledge of the country, and having a vital interest in the result of the struggle. On the other hand was a rabble, drawn largely from the lowest strata of Parisian humanity, with only a few weeks of experience of war, and so undisciplined that it was only by the severest and most degrading punishments and threats of instant death that their General (Dumouriez) was able to maintain any reasonable exercise of authority. The courage with which these men were possessed was largely of an emotional character, and although rendering them capable, under the influence of Revolutionary ardour, of actions of the sublimest heroism, it was equally prompt in the absence of excitement, and under adverse circumstances, to desert them absolutely, leaving them a prey to the most contemptible forms of panic. Any anticipations, based on the character

* Although the King of Prussia was present, the immediate command devolved upon the Duke of Brunswick.

of the opponents, which were entertained at the time as to the result of the conflict, failed completely of realization.

Not only was the Prussian attack repelled with complete success, but was followed on the day succeeding the battle by the retirement of the invading forces, and their pursuit (although not a vigorous one) by the victorious French. That a chivalrous and gallant monarch should, after failure in a single encounter, abandon definitely a struggle fraught not only with momentous issues to the order to which he belonged, but also one in which his honour and reputation were deeply concerned, and withdraw his army in hurried retreat before what was little better than an armed mob, is a matter which cannot fail to excite both surprise and interest. The history of the events preceding the engagement furnishes, however, the explanation of an otherwise unaccountable fact, and at the same time constitutes evidence that the defeat of the Prussians conveys no reflection on their conduct, and that the main factors which contributed to this result were distinct from the genius of Dumouriez and the valour of the Republican army. The occupation of a comparatively stationary and purely defensive position in a country friendly to their cause had enabled the French to obtain the necessary means for the maintenance of physical efficiency. The Prussians, on the contrary, were constantly on the move, being engaged in a series of efforts to outflank a formidable position. Their condition cannot be better described than in the words of Carlyle : ' Days of a rain of Noah, without fire, without food. For fire you cut down green trees and make smoke, for food you eat green grapes and produce colic,

pestilential dysentery. And the peasants assassinate us, they do not join us; shrill women cry shame on us, threaten to draw their very scissors on us.' The exhausted condition of the invaders may also be inferred, not only from their failure to renew the attack, and their subsequent retreat, but also from the circumstance, likewise set forth by Carlyle, that in occupying the position of his beaten enemy 'Dumouriez finds ghastly symptoms in that camp, latrines full of blood.'

Had the contest ended in the defeat of the French, there is every reasonable ground for believing that the victorious Prussian army would have entered Paris, that the Revolutionary leaders would have fallen, and that a Bourbon might now be on the throne of France.

The 'pestilential dysentery' was productive of consequences too evident to be further dwelt on here.

NOTE.—The following extract from the life of General Dumouriez ('Vie et Mémoires du Général Dumouriez,' Paris: Beaudoin Frères, 1822) may serve to emphasize previous statements concerning the exhausted conditions of the Prussians and the military qualities of their antagonists:

'Il écrivait au Ministre et à l'Assemblée qu'on n'eût aucune inquietude, qu'il répondait des événements, que non seulement les Prussiens ne feraient plusde progrès, mais que sous dix jours au plus tard, cette armée formidable consumée par la faim et par les maladies serait obligée de faire retraite et qu'on s'en tirerait fort mal.

'Dumouriez envoya sur le champ le Général Dampierre avec une Brigade de l'Infanterie pour occuper le

camp de la Lune qu'on trouva plein de cadavres d'hommes et de chevaux. Les fosses d'aisance étaient pleines de sang, de malheureux soldats qui étaient tombés et qui avaient péri. Dampierre fut obligé d'abandonner aussitôt le camp, pour ne pas infecter ses soldats de cette épidémie.

' Les mois de Septembre et Octobre furent affreux et achevèrent de détruire les Prussiens. Les Français souffraient aussi considérablement, mais leur camp était beaucoup meilleur. Ils avaient du bois et de l'eau, ils ne manquaient jamais du lard, de la viande, du riz, et de l'eau de vie.

' Cette armée formidable perd plus de trente mille hommes, dont tout au plus deux mille par les armes . . . et se retire en Allemagne. Tous ces événements, qui tiennent du merveilleux, se passent en moins de six semaines et la France est sauvée d'un des plus grand dangers que présentent nos fastes.

' Son armée qui n'est que de vingt trois mille hommes reste sans généraux, sans officiers supérieurs, desorganisée, consternée. Dans le même temps, un roi puissant, à la tête de quatre-vingt mille hommes, entre en France.

' Ils avaient coupé la tête à quelques officiers qui avaient voulu leur faire entendre raison. Ils arrachaient aux officiers de troupes de Ligne leurs épaulettes et leur croix de St. Louis, et ils assassinèrent le Colonel du Regiment de Vexin qui avait résisté à une pareille insulte.

'Ils ne se connaissaient pas entre eux, n'obéissant ni à leurs chefs, ni à leurs généraux, et ne semblaient connaître d'union, que lorsqu'il s'agissait de commetre des atrocités.

'Il écrivit au Président. J'ai été obligé d'abandonner le camp de Grand Pré, la retraite était faite lorsqu'une terreur panique s'est mise dans l'armée. Dix mille hommes ont fui devant quinze cents Hussards Prussiens.'

The above statements may appear to be unduly discursive, and equally irrelevant, but they have been introduced with the object of emphasizing the extreme interest and importance of the present subject, and to indicate as far as possible the lines on which its study may be successfully followed, by making evident what seem to be the main reasons for its tardy advance in the general march of scientific knowledge.

These reasons, as already stated, appear to consist partly of a failure to apply to the science of medicine those methods of reasoning which comprise a just appreciation of the relationship between cause and effect, and partly of a failure on the part of military historians to estimate the true value of certain facts in the sequence of events which it is their object to record.

It is only fair to add that, had the progress of medical knowledge depended entirely on those who had made the science in question their calling, and had it consequently been free from the interference of external influence, the first cause of failure to advance, named above, might have been non-existent.

In discussing the actual subject of military sanitation in the field, it would seem convenient to trace, if possible, a causal relationship between surrounding conditions and those diseases to which, from personal experience, I have found the soldier on service to be peculiarly liable; secondly, to discuss those administrative matters (including *materiel*) which are not connected exclusively with the spread of any particular disease, but the influence of which is more or less of a general nature; and, thirdly, from the conclusions arrived at, to indicate what would appear to be the right lines for future action as affecting the present question. I should here state that the principles which I shall endeavour to set forth, although referring particularly to our own army, should nevertheless admit of general applicability as regards military service in the field.

CHAPTER II

DISEASES OF THE SOLDIER IN THE FIELD

Enteric Fever

As the current views concerning the etiology of enteric fever are amply set forth in leading text-books, and have been fully discussed in the medical press, they need no recapitulation on my part. On the other hand, a statement of my own views and experience, in the form of a narrative (which I shall endeavour to make as concise as possible), would appear to be quite consistent with present purposes. My first experience of this disease in a truly epidemic form was at the close of 1885 and during the early part of 1886. I was at this time stationed at Korosko, a small Arab settlement on the east bank of the Nile, about midway between the first and second cataracts.

The native inhabitants were scattered as regards locality, and inconsiderable as regards numbers. They were occupied solely in a primitive form of agriculture, and I never heard that any form of endemic disease existed amongst them.

The river ran in the immediate proximity, and on the western side of the camp. To the east, and distant about half a mile, the horizon was closed by arid and rocky hills, while to the north and south was the

narrow fringe of cultivation parallel with the stream, which is the usual type of fellaheen agriculture. The soil of the camp was arid, sandy, and absolutely devoid of vegetation. I had been stationed at this spot for two months during the previous summer, when, except for a local form of fever, which attacked nearly all European newcomers, the general health of the troops had been excellent. I should here make it perfectly clear that the endemic sickness which I have just referred to, bore no likeness whatever to accepted descriptions of enteric fever; that it appeared to be limited exclusively to Europeans; that it never lasted more than a few days; and that, as far as I am aware, it had no sequelæ of any kind. When I was ordered to proceed to Cairo in July, 1885, I had not, during my stay of two months, seen a single case of enteric fever amongst either officers or men, out of a total strength of about 850, and the general health was, in every respect, excellent.

I should add that a most scrupulous system of sanitation was in force.

Shortly after my arrival at Cairo, I was placed in medical charge of a company of mounted infantry under orders to proceed by steamer to Wady Halfa. Our progress up the Nile, owing to the weight of the barges conveying the horses, which were towed by the steamer, was necessarily slow, and a period of fully two months elapsed between our departure from Cairo and our arrival at our destination. During this period the men certainly did not confine themselves to boiled water for drinking purposes. Filtration in those days meant allowing the water to trickle through the germ-laden pores of a filthy earthenware jar, and to collect

in another receptacle of a somewhat similar nature. It will thus be apparent, although it is only evidence of a negative character, that if enteric fever was derived solely from Nile water, the unit in question should have suffered severely; but not one single case of this disease occurred from the day we left Cairo to the day on which we completed our journey. On landing at Halfa I was ordered to proceed to Sarras, an isolated post some miles south of the second cataract. The climate and topographical conditions of this locality were practically the same as those in existence at Korosko, with the important difference that Sarras had not been occupied for many months by any but small bodies of troops, and therefore for sanitary purposes might be considered as virgin soil. I remained at this spot during the whole of November and the early part of December, 1885, altogether about six weeks. During this period, for reasons which I need not enter on here, sanitary precautions were in the main omitted; even the crude method of filtration which I have mentioned was largely neglected, but perhaps this was just as well. The heat of the day was only equalled in intensity by the cold of the night. Tents, which were altogether inadequate for the numbers present, were struck at sundown, and in many cases the men were without blankets or extra cover of any kind, except the great-coat.

The average strength was about 300 of all ranks, and out of this number I never saw a case of illness which bore the faintest resemblance to enteric fever; on the contrary, the general health left nothing to be desired. Very shortly before Christmas, as already stated, I was again at Korosko, and found since my departure in the

previous July that all the tents had been replaced by mud huts, and that many comforts previously unknown were now in existence. The scrupulous system of sanitation which, in my experience, had always been carried out was carefully maintained, including in particular the careful boiling of drinking-water.

Bucket latrines had, however, been substituted for trench latrines. The contents of the buckets were carefully buried at a suitable distance from the camp, and the latrines established well away from the huts. The strength at this time was about 700 of all ranks. In spite of the above precautions, enteric fever developed during the winter months to a most serious extent, and was accompanied by dysentery of a severe form. The contrast between this state of things and that which had existed in the same locality during the preceding spring and summer, and at Sarras during November and December of the same year, is sufficiently striking to excite considerable surprise. At Sarras and Korosko, as already stated, the conditions as regards natural surroundings were practically identical, and any explanation of the difference as regards health on the ground of disparity in numbers would scarcely be consistent with a theory of water-borne enteric from the Nile, particularly as the drinking-water at Korosko was religiously boiled, and that at Sarras was, for the most part, consumed without any precautions whatever. It should also be stated that at Assouan and Wady Halfa, particularly the former, both being old-standing camps, enteric fever was steadily increasing, in spite of a rigid maintenance of sanitary vigilance. While, however, the disease was gaining a sure foothold in the camps, the men of the mounted infantry living

under conditions already named, with the exception of an outbreak of ophthalmia, remained singularly free from any kind of sickness. Whether the following explanation of these facts is correct or otherwise, I would not venture to say; it is set forth with considerable diffidence, but at least I can claim for it that it appears to be justified by the light of practical experience.

Since I had left Korosko in July the ground had been in continued occupation by troops, and the Nile had almost completed its annual rise and subsequent fall. The soil of even the best administered camps tends, sooner or later, to become impregnated with organic matter of various kinds. When the nitrifying* organisms of the soil are not overtaxed this organic is reduced to inorganic matter, which latter, where plants are present, is next taken up as food for the vegetable world, and the energies of the soil organisms are again set free to recommence their task should occasion call for it. When, however, vegetation is absent, or when organic material is excessive in amount, the powers of the organisms in question being unable to meet the labour imposed on them, there must remain a residue of unreduced matter, which, coupled with the presence of moisture and suitable temperature, would form an excellent medium for microbial growth. The sandy soil of Egypt is dry and highly permeable; the rise of ground-water due to the corresponding rise of the Nile would supply the necessary moisture, and the conduc-

* Nitrification is, of course, only the final state of the process of reduction. The word 'nitrifying' is here used for purposes of convenience, and is meant to include all the steps of transformation of organic into inorganic matter.

tion of heat from the surface would furnish everything requisite as regards temperature.

Although I cannot here attempt a detailed discussion as to the mutability of bacteria, nevertheless I do not think that I am wrong in stating that such a theory of mutability is quite in accordance with ascertained facts of Nature, and receives particular support from what we know as to the influence of external conditions on the biological and morphological characteristics of microbial forms of life. Any theory which assumes the possibility of the transformation of the colon or other bacillus into the *Bacillus typhosus* is particularly convenient, as it not only fits in with facts which are too well known to admit of discussion, but it also does away with the necessity for admitting the existence of an antecedent case of enteric fever as requisite for an outbreak of the same disease. Taking all the facts stated above into consideration, it seems likely that such transformation must here have taken place, the essential microbe being subsequently disseminated through the medium probably of dust, and also of flies, while once the bacillus was brought into existence it would find a suitable medium for perpetuating itself in any basic nitrates which might be present as a result of the reduction by soil organisms of organic matter.

The following figures, copied from the Army Medical Reports, are of interest, as showing the increase of enteric fever consequent on prolonged occupation of certain localities.

In 1885, in the Frontier Field Force, which comprised the stations of Assouan, Korosko, and Wady Halfa, the annual death-rate from all causes was 28·70

per 1,000, and the year following it was 70·51 per 1,000. Although these figures refer to mortality from all causes, the deaths in the vast majority of cases resulted from enteric fever.

Official statistics which can be used for purposes of comparison in connection with enteric fever only are not available for the dates in question. In spite of this fact, the above figures are sufficiently striking.

The actual number of cases of enteric fever occurring is given below, but unfortunately, although these figures are of considerable interest, as throwing additional light on those quoted immediately above, they are not in themselves reliable as a means of comparison, as they do not comprise two complete annual periods.

1885.	Cases.	Deaths.
Assouan	28	8
Korosko	16	6
Wady Halfa	24	6

1886.	Cases.	Deaths.
Assouan	276	97
Korosko	28	16
Wady Halfa	98	37

The strength during the above periods was approximately constant.

The sixteen cases shown as existing at Korosko in 1885 occurred in the first Battalion Yorkshire Regiment, which had been sent from Assouan early in the autumn to relieve the Queen's Own Cameron Highlanders. A few of these cases were without doubt contracted at

Assouan. One officer at the time he landed was well into the second week of the disease. It seems, however, scarcely likely that these cases can have had any connection with the outbreak that took place at the close of the year. The slight incidence of the disease at Korosko in 1886, as compared with that at Halfa and Assouan, was due in part to a considerable disparity in strength, and also to the fact that the first-named locality was abandoned as a post for British troops comparatively early in the year. Korosko was officially reported as being, previous to the above occurrences—that is, during the first half of 1885—'exceedingly healthy.' Of course, it has been contended that the disease was endemic in the native population, but, although I had during 1885 and 1886 a fairly extensive experience of the fellaheen in a professional capacity, and in such constantly visited their villages, I never saw a case of illness which bore any resemblance to enteric fever. These people were always eager to obtain the services of a doctor, and they had no reason of any kind to conceal the existence of disease. Neither is it likely that an endemic sickness would delay in attacking newcomers, yet it was notorious that enteric only made its appearance amongst troops after they had been camped on the same ground for a varying period, but practically never immediately after occupation.

The case of the men of the various Regimental Camel Corps may also be cited in connection with the local origin of the disease. These men were employed in patrolling the various desert roads, with the object of intercepting slave caravans and checking illicit trading with the Soudan. The men were therefore removed

from what may be termed infected areas—viz., the camps. I can speak from personal experience of the excellent effect of this duty on the health of those who were engaged in it, and this in spite of the fact that exposure to excessive heat by day and equal cold by night, with very scanty covering on the latter occasion, was sufficiently trying, and also that the water for drinking purposes was drawn straight from the Nile, and carried in bheestie skins which were certainly not of the cleanest. None of these men—or rather none of those of them of whom I had any experience—ever, to the best of my recollection, contracted enteric fever, at a time when their comrades in camp were suffering severely. The influence of removal from a polluted area is here sufficiently apparent. When not patrolling, the men were located apart from the remainder of their battalion, on ground which, in view of the occasional nature only of its occupation, was not subjected to those constantly polluting influences which obtained elsewhere.

I should here state that I have no intention whatever of attempting to throw doubt on such a well-established fact as the existence of water-borne enteric fever, and I fully realize the extreme importance of modern methods of water purification, my main contention being that the influence of water-supply in this particular connection has in the past been, *comparatively speaking*, overrated, and that other disease-producing factors, notably soil pollution, tending in the like direction have either been overlooked or relegated to a position of minor importance, and this opinion has received considerable justification in the light of further experience.

On December 24, 1899, I arrived at Estcourt, Natal.

The position of this town is doubtless too well known to need any detailed statement concerning it from me ; suffice to say that it was the appointed rendezvous of the Fifth Division, which was shortly to join the remainder of the Ladysmith Relief Column on the Tugela. The units which were comprised in the Division arrived irregularly during the following days, and I think that their average stay at Estcourt must have been about two weeks. The weather was tempestuous, but changeable. Rain fell in torrents ; the camping-grounds were more or less ankle deep in mud. The water, drawn mainly from the Bushman River, was laden with sediment. Filters were, as a rule, conspicuous by their absence, and if the drinking-water was ever boiled, I certainly never heard of it. I made one attempt to supply the men of my own unit with boiled water for drinking purposes, but as the camp fires, owing to the heavy rain, could only be kept alight with difficulty, and as I was largely devoid, as I very soon found out, of requisite appliances for my purpose, the scheme had to be abandoned.

In spite of the above adverse circumstances, the general health of the men remained good, although a certain form of mild diarrhœa was fairly prevalent. One case of enteric fever was admitted to the Convent Hospital. It should here be particularly noticed that the camping-grounds had not been previously occupied by large bodies of troops during any length of time.

On January 8 orders were issued concerning the line of march, and up to this time, with the exception of the case just alluded to, there had been no indication, as far as I am aware, of any form of serious illness in the force.

On January 9 the tents were struck before 3 a.m., and by 3.30 the column was on the march. There was no opportunity for a meal of any kind, great-coats were not worn, and as it rained in torrents the men were soaked to the skin in a few minutes. A halt was called at mid-day at an impassable drift. The mud was literally knee deep, and as no pontoons were available, the whole force had to remain stationary until a crossing could be effected about five o'clock in the afternoon. During the halt some of the men obtained biscuit, but the majority got nothing at all, and on our arrival at Frere we found that the ration meat, having only just been killed, was absolutely uneatable. The men slept in their saturated clothing, and marched again on the following day—viz., January 10—at mid-day. Rain again fell heavily. The track was, of course, as bad as it could be, and, as waggons and guns stuck repeatedly, our progress was necessarily slow. At every halt men threw themselves down to sleep on ground saturated with rain, and in bitter cold. The march was prolonged throughout the night and throughout the following day, until we pitched our tents at Springfield Bridge at midnight on January 11. Since we left Estcourt on the 9th the men had been almost incessantly on the march. They had been saturated with rain, they had been exposed to extremes of both heat and cold, and had had no proper allowance of either food or sleep.*

These details may appear to be altogether irrelevant, but they have been introduced with the object of

* These statements are only intended to apply to my own personal observations ; units of which I had no immediate knowledge may have fared better.

emphasizing the fact that men whose vitality was largely exhausted by such conditions as those which I have endeavoured to describe might, having regard to existing views, have been expected to readily acquire water-borne disease from the various pools and streams, of the contents of which they had freely partaken. Nothing of the kind, however, occurred, and it was not until the close of January, as far as my experience goes, that sickness began to show itself in a serious form. I do not wish to assert that the force was in a high state of physical efficiency. Diarrhœa of a mild type was prevalent; there were some few cases of undoubted dysentery; old soldiers who had served in India suffered severely from ague; and rheumatic affections, particularly among the class just named, were extremely common. The remainder of the march after leaving Springfield was carried out in easy stages, and does not call for special comment.

The main body of the Relief Column reached the Tugela or its immediate proximity on January 17, and from that date to our retirement consequent on the battle of Vaal Kranz, a certain area of veldt known as Spearman's Plain, in the vicinity of the river, but separated from it by a range of hills, was in constant occupation by various units of Buller's army. An advanced force under Dundonald had, however, held this ground before the arrival of the rest of the column. It was here, at the close of January and the beginning of February, that epidemic sickness first made its presence felt. The ground had been occupied for a sufficient period to become more or less saturated with filth. The heat during the day was intense, and the moisture necessary for the maintenance of microbial

action was supplied by the heavy rain. Diarrhœa accompanied by fever of an irregular type constituted a grave warning that something was radically wrong. The worst among the cases were sent by sick convoy to the hospitals on the lines of communication. What percentage of these cases proved to be enteric fever I have no means of knowing, but, as will appear later on, it must have been considerable. A certain number of the men recovered after a few days' illness and returned to duty.

The drinking-water at this period of the campaign was drawn from the Great and the Little Tugela and their neighbouring springs, sources which for many years have formed the supply of a singularly healthy community.

By the beginning of February enteric fever in an undoubted form had made its appearance amongst us.

That the advent of epidemic disease was due to some purely local condition is, to some extent, proved by the following fact. The range of hills to the north of Spearman's Plain, and overlooking the Tugela, was held by the men of the Naval Brigade, and after the battle of Spion Kop a 5-inch Battery of Royal Artillery was added to the above force. The distance from that part of the summit held by the seamen to the camp in the plain was about a quarter of a mile, while the 5-inch Battery must have been distant about a mile and a half. As far as my remembrance goes, not a single man of the Naval Brigade or of the 5-inch Battery contracted illness in any serious form during the hostilities which took place on the Tugela during January and the early part of February, 1900, and from the nature of my duties during this period it is unlikely

that any such occurrence would have escaped my notice. The men in question were subjected to the same general conditions of service as those which affected the rest of the army, except for the important fact that in proportion to their numbers they were in occupation of a far more extensive area of ground than was the case as regards any other of the units.

On February 10 the army had begun its retirement from the Tugela. The close of the first day's march brought us to Springfield Bridge, where a force of about 3,000 men was left to hold the passage of the Little Tugela against the enemy in our rear, while the main body proceeded to Chieveley. I was ordered to remain with the first-named force. The ground at Springfield had, as already stated, been occupied by the army during its advance, and the soil of our camp was in consequence seriously polluted. The position was held until February 21, when we marched to rejoin the rest of the army at Chieveley and Colenso. During the days of our stay diarrhœa and fever were rife amongst officers and men. The most serious cases were sent to the hospital at Frere. For the most part, they received a provisional diagnosis only, and I had no means of ascertaining their further history as regards individuals, and although I can therefore furnish nothing in the way of a record of cases, there is no doubt whatever, in the light of information supplied from hospitals on the lines of communication, that a very high percentage of men sent away from the front marked 'Simple Continued Fever' and 'Diarrhœa' subsequently developed enteric fever in an unmistakable form; indeed, the existence of the disease in question

was fairly established amongst us before our departure for Chieveley on February 21. The above experience was repeated again and again throughout subsequent periods of the campaign.

At Olivier's Hoek, a typically healthy spot situated

Fig. 1.—*Scene near Summit of Drakensberg.*

The surroundings were typically healthy, and the water was of excellent quality, and drawn from rock springs. In spite of these advantages enteric fever occurred (in a mild form) among the troops in the district.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

almost on the summit of the Drakensberg, where the water-supply was of undoubted purity, where the importation of disease was beyond the limits of reason-

able possibility, and where no previous source of contamination of either soil or water could be reasonably supposed to exist, enteric fever appeared in the month of January, 1902. The camp had been occupied for some months before the disease broke out, and although every possible sanitary precaution was most faithfully carried out, the avoidance of soil pollution was a matter of impossibility. At Dyson's Farm, in the Bethlehem District of the Orange River Colony, the same occurred, but on a far more serious scale. During the month of February, 1902, the farm building and the neighbouring blockhouses were occupied by a company of the 2nd East Yorks Regiment, the majority of the men being in the blockhouses. The soil about the immediate vicinity of the farm was in a most filthy condition, as the numerous columns which had halted there had only paid slight attention to sanitary requirements, and had left behind them striking evidence of their failure to establish latrine trenches. The drinking-water was obtained from a spring, but, as I considered it likely that surface washings would cause contamination of the supply in question, I recommended boiling as a very necessary measure of purification. In spite of this precaution, three cases of enteric fever in the very small force in occupation occurred in one week, and two of these cases proved fatal. Other cases rapidly followed, and the building had consequently to be abandoned. Of course, it may be argued that my recommendation concerning the drinking-water may not have been carried out. Admitting this neglect as a fact (which, however, I do not for one moment believe), simply for the sake of argument, it by no means invalidates my contention as

regards soil pollution. Whether the bacillus of enteric fever was swallowed in the form of dust, food, or water, makes no possible difference as regards its origin. As in the case of Olivier's Hoek, importation of the disease may be disregarded. The *fons et origo mali* was clearly of local causation, and although incapable of scientific proof, its existence in the soil becomes the only reasonable explanation of the facts which have just been recorded. It is, in fact, perfectly clear that any enteric germs which may have existed in the water must have gained entrance into it from the polluted surroundings. Again, some of the worst cases of enteric fever that I have ever seen have originated among men who have been employed on blockhouse duty for long periods, and who, while so engaged, have consumed nothing in the way of liquid except tea and coffee.

Such cases are, however, rare in my experience, but concerning their existence there is no manner of doubt.

The floors of the blockhouses were not formed of any impermeable material, but, consisting only of earth, rammed more or less hard, they were highly absorbent, and therefore difficult, or rather impossible, to keep clean.

The space in which the men lived was extremely limited. The habits of many soldiers as regards sanitary matters are not beyond suspicion, and that the soil, therefore, inside these structures should become seriously polluted is not a matter which need excite the smallest surprise.

To attempt to prove a negative as regards the influence of water on the causation of enteric fever during the recent campaign would, of course, be out of the

question, especially as boiling and filtration were by no means universal. On the other hand, to maintain that sources of water-supply which for many years have been used with impunity by the inhabitants of healthy districts should, on the occurrence of hostilities, be the principal cause of an outbreak of epidemic disease in one of the contending forces involves an inability to apply those principles of reasoning from cause to effect which have already been alluded to, and, in short, does not appear to be consistent with the dictates of ordinary common-sense.

It is of great interest here to note that, according to information most kindly furnished me by Dr. E. Hill, Medical Officer of Health for Natal, during 1902, the first year of notification throughout the Colony, there were no cases of enteric fever reported from the neighbourhood of the Tugela in the area of the Relief operations. This bears out previous statements relative to the health of local inhabitants before the war, although it is right to add that my information in this connection, in the absence of official records, was (with the above exception) derived from private sources, which latter, however, I have every reason to believe were perfectly reliable. At any rate, Dr. Hill's information is scarcely consistent with the existence of a permanently polluted water-supply. Dr. Hill also informs me that the highest incidence of enteric fever corresponds with the maximum rainfall and maximum air temperature. It is likewise well known that in Natal enteric fever has its stronghold in towns where soil pollution would tend to be excessive. These facts, taken collectively, are all confirmatory evidence of the existence of soil pollution as a factor in the production

of enteric fever, and are quite consistent with what we know as to the influence of food, temperature, and moisture on the growth and activity of germs.

There is here, as already stated, no intention to combat the doctrine of water-borne enteric fever, the evidence in this connection being of an irrefutable character; but in my experience, where the water has without doubt been at fault, it was constantly found that the source of supply had been fouled by the washings of a polluted soil.

Dust and flies are, on good grounds, accepted as important factors in the dissemination of the disease. Those who during the recent campaign have had mouth and nostrils caked with the filthy dust blown through the camps, and have watched the disgusting bottle-green latrine flies crawling over articles of food which were about to be consumed, will have no difficulty in accepting the theory that disease of a sufficiently extensive nature must spread by the means just indicated.

These and other agencies in the same direction, such as milk and other articles of food, have received full attention in medical literature, and need not, therefore, be further dwelt on here, while, on the other hand, the consideration at some length of the effects of soil pollution does not appear to be out of place, as this last-named subject has not, as far as I am aware, received the attention which its importance would seem to merit.

NOTE.—The official figures relating to enteric fever in the army in South Africa for December, 1901, to February, 1902, were made public (*British Medical Journal*, May 10, 1902). They are as follows:

Admissions, 6,379. Deaths, 953.

And the like period during the preceding year shows :

Admissions, 5,905. Deaths, 1,042.

On Tuesday, May 6, 1902, Mr. Brodrick stated in the House of Commons that most of the cases were coming from trekking columns, and that comparatively few were occurring in camps and garrisons. This statement would not appear to lend support to the preceding contention relative to the influence of soil pollution on the production of the disease, but the apparent contradiction is easy of explanation. Columns, as a rule, could only outspan in certain definite localities where water was obtainable. The same spots were thus occupied over and over again, until they were absolutely saturated with organic filth ; and it is notorious that many columns were regardless of the condition in which they left their camping-grounds.

I have often been forced to outspan on ground filthier than any that I have ever seen in any standing camp, and it is evident that men who on trek were forced to eat and sleep under such conditions were exposed to all the detrimental influences on health due to the polluted soil of a camp, without the compensation of those sanitary precautions which can only be effectively carried out among stationary bodies of troops. During the early stages of the war the halting-places for columns were unpolluted, but the result of continued occupation would naturally, with the progress of time, grow from a negligible quantity into a disease-producing factor of prime importance.

The difference between the above sets of figures being, in view of the numbers in the field, comparatively speaking, slight, does lend material support to a theory

of soil pollution, but it must be remembered that a large number of fresh localities were occupied by our troops during the latter of the two periods referred to; also that a variety of sanitary reforms had been instituted in standing camps and garrisons, and that these reforms would naturally tend to an elimination of certain causes of sickness (notably pollution of soil) which existed during the earlier periods of the campaign, and would thus counterbalance the effect of conditions referred to above as affecting mobile troops. The greater incidence of disease on trekking columns would also in part be accounted for by the fact that during the second of the above periods the troops in standing camps were, in regard to number, inconsiderable as compared with those engaged in duties of the nature first referred to.

Dysentery.

The main causes of dysentery are well known and fully detailed in standard works of reference, and to restate this information at present would therefore constitute a gratuitous act of repetition. There are, however, certain facts in connection with the causation of this disease which have either been omitted from the literature named, or have only been casually referred to, and it is these facts in particular that I propose to consider somewhat in detail.

As in my experience dysentery appeared at about the same periods and under very similar conditions as those set forth in the case of enteric fever, it seems fair, applying the same lines of argument in each case, to regard soil pollution as a leading agent in the causation of the first-named disease. This statement cannot, however, be accepted without some modification, as,

although the correspondence as regards the causation of these diseases is sufficiently apparent, there exists nevertheless in this connection certain differences of a striking character.

1. That the effect of soil pollution in producing dysentery is, as a rule, far less marked than in the case of enteric fever. As far as my experience goes, the advent of enteric fever precedes that of dysentery. When these diseases occur in standing camp, the number of cases of the former disease is out of all proportion to that of the latter—at any rate, at the beginning of an epidemic, after which the prevalence of dysentery steadily increases. I do not, however, wish for a moment to assert that this rule is universal. Perhaps a fair way of setting forth the case in general terms would be to state that the immediate effects of soil pollution are more immediately apparent as regards enteric fever than as regards dysentery.

2. That, although dysentery may not, under the conditions in question, make its appearance with the same promptitude as enteric fever, there is reason to believe that its powers for evil persist in the soil of certain localities after all sources of pollution have been removed, with a tenacity which is unknown in the case of enteric fever. At Tyger Kloof, in the Orange River Colony, an important camp on the Harrismith and Bethlehem Blockhouse Line, careful sanitation had been followed by excellent results as regards stamping out the spread of enteric fever, while, in spite of every possible precaution, it was impossible to do the same as regards dysentery.

About three weeks subsequent to the Relief of Ladysmith the unit of the Relief Column to which I was attached was ordered to encamp on the north side of the

above town on ground which had previously been occupied by a Boer laager. Dysentery broke out almost directly after our arrival, and the same disease was prevalent throughout all the other camps in the vicinity. It was a matter of common knowledge that the Boers had suffered both from enteric fever and dysentery while camped on this ground. The only disease, however, which they appeared to have left behind them was dysentery. It is only fair to state that the water was about the worst possible; but this could by no means have been the sole cause of our trouble, as the disease found many victims amongst those who had only partaken of boiled or filtered water. I may add that at this period of the campaign my unit first became possessed of a Berkefeld filter.

An experience very similar to the above was encountered at Glencoe in the Biggarsberg; the Boers had vacated their laagers several days before our arrival, and the legacy of disease which they bequeathed to us took the form of dysentery only, but, nevertheless, on a sufficiently extensive scale. That the enemy had suffered from enteric fever about this time is a fact about which there is no doubt whatever. It would appear from the above that the essential cause of enteric fever dies out in the soil if the supply of organic material is cut off or largely reduced, while in the case of dysentery the *materies morbi* is far more tenacious of life, or—what amounts to the same thing—is far less dependent generally on surrounding conditions for the continuance of its existence. I do not wish to assert, in this connection, that the army was free from enteric fever, as it was very far from anything of the sort. On the contrary, enteric fever existed to a very serious

extent; but although its advent preceded as a rule that of dysentery in camps which had not been previously occupied, the order of appearance was reversed when a varying interval of time had elapsed between the successive occupation of a camping-ground by different bodies of troops. The facts on which the above statements are based are, of course, far too meagre to justify the formation of any definite opinion, and I am not aware of any records which would throw light on this question. To compile any such records in connection with a mobile force would be a matter of exceptional difficulty.

My statements comprise, therefore, little more than a suggestion, but the matter in question is not devoid of practical as well as of scientific interest, and would therefore appear to be worthy of future investigation.

3. I have constantly observed in camps, when both enteric fever and dysentery were rife, that where enteric fever struck alike at strong and weak, dysentery mostly found its victims amongst those who were suffering from some disordered condition of the alimentary tract. This statement is largely borne out by the experience of others, and its importance from a practical point of view is of course evident. This is a matter which will be further considered later on.

There is evidence to show that the essential cause of dysentery is a free living organism of both soil and water, and that, like other diseases, it attacks man when his vital condition is favourable for its reception and growth, and that it possesses remarkable powers of disseminating itself throughout communities into which it has been introduced, or in which it has of itself sprung into existence. The latter mode of origin, apart

from means already set forth in this connection, may here be particularly considered. There is strong reason to believe, without in any way vitiating previous statements, that the essential cause of this disease may, under certain morbid conditions, have its origin in the intestinal tract of man ; that, being there formed from some pre-existing organism, it may attack its own host, by whom it is voided with the fæces ; and, assuming the accuracy of the above, that it enters the body of its next victim in a fully-developed form.

Isolated cases are of constant occurrence on the line of march, when there has been no question of infection from a previous case, and in localities where the disease is unknown. One of the worst cases that I have ever seen, in which death supervened about twenty-four hours after the appreciable onset of the disease, occurred under circumstances which precluded the possibility of direct infection, and the attack could certainly not have been due to any influence of a widely-spread nature, as no cases had occurred in the regiment before the one in question, and no further cases followed.

Apart from clinical signs, post-mortem examination left no doubt as to the nature of the malady.

Perhaps the strongest evidence that can be brought forward at present in support of an intestinal origin of the dysenteric germ is to be derived from further reference to the history of the Valmy Campaign, already dwelt on at some length. The district of Argonne, in which the operations in question took place, is by no means noted for dysentery, and certainly if the extent to which the Prussians suffered had been due to endemic causes, that region of France would have been

rapidly depopulated, or, rather, would never have been populated at all. The peasants of the district were free from the disease, and the army of the Republic did not suffer to anything approaching the extent of that of the invaders.

To state that the Prussians must have brought the disease with them constitutes an absolutely gratuitous assumption, altogether unsupported by fact, and one which only lands us one step further back in the argument. If the essential cause of the disease did not have its origin in the disordered intestines of the Imperial troops, it is difficult to arrive at any conclusion as to how it could have possibly come into existence.

In this connection, I would quote from the 'Theory and Practice of Hygiene,' by Notter, Firth, and Horrocks: 'Besides the presence of undoubted infection in primary dysentery, there is also a probable acquired infection developed from primary diarrhœa, just as there is a probable occurrence of a progressive development of the property of infectiveness in simple sore throat up to a condition of diphtheria. The gradually developed infection of dysentery grafted on diarrhœa is nowhere better seen than in the experience of military campaigns. Although true dysentery is a disease *per se*, still, on service the causes predisposing to the ordinary forms of simple diarrhœa will, if persistent, also predispose to the true spreading epidemic dysentery.'

The above passage puts the whole matter in a nutshell, and the practical inference to be drawn from it is sufficiently clear.

It should, of course, be understood that the term

'dysentery' is here used only in a clinical sense, although without doubt implying belief in the existence of a causative agent in the shape of an undiscovered germ. The researches of Shiga, of Tokio, and Flexner, of Philadelphia, are of great interest in this connection, and will well repay careful attention.

The question of the origin of dysentery in organically polluted soils has already been discussed, and there are also excellent grounds for the belief that water, when fouled with fæcal matter, may also be productive of the disease; but of the latter point I have no precise knowledge on which I can base an assertion.

Diarrhœa

It is impossible to discuss either adequately or accurately the various pathological conditions which may be grouped under the above heading, but, excluding those forms of diarrhœa which are symptomatic of diseases generally known as specific, the following classification, without purporting to be either inclusive or scientifically accurate, may answer purposes of practical convenience:

1. Diarrhœa due to food.
2. Diarrhœa due to water.
3. Diarrhœa due to dyspepsia.
4. Diarrhœa due to chill.
5. Diarrhœa due probably to a specific organism.

Diarrhœa due to Food.—This may be the result of mechanical irritation from such substances as Indian corn or coarse oatmeal. The symptoms are not severe, and the general health remains good. I believe that

eating Indian corn, generally known as mealies, was a common cause of diarrhœa in South Africa. The more serious forms of diarrhœa resulting from food are, however, generally brought about by some active chemical principle of either a vegetable or an animal nature.

The former would be contained in various fruits of which soldiers, who at times are very like children, are quite ready to partake in absolute ignorance of possible results. Of course, the symptoms may be of any degree of severity. There is a well-known fruit of tempting appearance in St. Helena (the botanical name I regret to say I have forgotten) which is valued by the natives for its powers of removing rust, and for acting generally as an excellent polish for metal. Soldiers have been known to sample this natural product with the most appalling results. It is no exaggeration to say that the man who escaped suffocation from œdema of the glottis, and who succumbed to gastro-intestinal inflammation, might be considered lucky. I have thought it worth while to instance this fact as an illustration of the danger into which soldiers are led by their own disregard of common-sense precautions, and it is in the field particularly that men fall victims to their own ignorance and recklessness.

A more frequent and, in view of its frequency, a more serious form of diarrhœa is that caused by some chemical substance of animal origin. Under this heading would come diarrhœa the result of ptomaine-poisoning, most probably produced by tinned food. As in the case of vegetable poisoning, the symptoms may vary in severity, but such cases as I have seen have certainly been most alarming. The attack either occurs

very shortly after partaking of the poison, or it may not supervene for several hours. In the former case the symptoms are usually the result of a poisonous ptomaine, alkaloid, or albumose already formed in the food; in the latter case they are due to the slow development of one or other of the above under the influence of microbial action. I have seen examples of both of these forms of poisoning. A case of the latter was that of an officer who had consumed the greater part of a tin of sardines about 11 p.m. At 2 p.m. on the following day he was seized with vomiting and purging, the temperature was subnormal, and he was in imminent danger, for several hours, of dying of collapse. The example about to be referred to of the first form of poisoning occurred also in the person of an officer. The attack supervened within an hour, or less, of consuming a 'preserved field ration.'

The symptoms consisted, as above, of violent purging and vomiting, but there were agonizing cramps in the lower extremities—a circumstance which was not present in the first-named case. The signs of collapse, however, were less marked, the temperature rose considerably, and the symptoms passed off comparatively soon.

Cases such as I have named have, in their initial stages, been mistaken, as I know, even by officers of extensive Indian experience, for Asiatic cholera; and as these attacks are apt to occur in the field where all sorts of highly-spiced offal are sold in the form of tinned provisions, and notably 'potted meats,' extreme precaution is required before arriving at a diagnosis. This point is sufficiently practical to merit very careful attention. In each of the above cases careful investi-

gation placed the cause of the trouble beyond any reasonable doubt. Metallic poisoning may also occur from tinned food, but of this I have no experience. There are, of course, other causes of diarrhœa associated with food, but none that I am aware of that are specially connected with service in the field.

Diarrhœa due to Water.—This may be the result of mechanical irritation from suspended matter, and I have reason to believe that a diarrhœa prevalent among the troops at Estcourt in the month of December, 1899, was due to this cause. The symptoms were not severe, and the general health remained good. When the condition is the result of chemical substances in solution, either of inorganic or of organic origin, the symptoms may be of any degree of severity.

In the field diarrhœa produced by organic matter in the water is often the result of allowing animals, or often the carcasses of animals, to pollute streams and rivers above the source from which drinking water is obtained. Many such instances occurred in the recent campaign. In one case I found a trek ox, which must have been dead several days, in the immediate vicinity of a spring from which the drinking-water of a camp of 500 men was to be drawn.

Diarrhœa due to Dyspepsia.—It is impossible to discuss every form of diarrhœa likely to arise from such a condition of widespread significance as that comprised under the term 'dyspepsia.' There is, however, in the field one form of flatulent diarrhœa which I have reason to believe is the direct result of dyspepsia attendant on the prolonged use of biscuit as an article of diet. I found this trouble to be very common among men on block-house duty, particularly in cases where

teeth were defective. An issue of flour with baking-powder was recommended and carried out among the block-houses of which I had charge, field-ovens being constructed at the same time, and I had every reason to be pleased with the result of these measures. Soldiers' teeth are notably bad, and biscuit is not likely to improve them ; mastication of any hard substance is attended with difficulty, and the general sequel of such a state of things is not difficult to foresee.

Without attempting to go into details which have no

Fig. 2.—*Block-House in the Harrismith District.*

The men on duty in these structures suffered considerably from dyspepsia, the result largely of lack of exercise. The condition was aggravated by the prolonged use of biscuit.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment)

practical value, it is safe to assume a general rule to the effect that disordered states of the digestive functions are particularly apt to be productive of diarrhœa among men eminently liable to exposure, and who, from the conditions under which they are placed on service, have not the means of meeting the various climatic vicissitudes to which they may be subjected.

Diarrhœa due to Chill.—This is often the result of carelessness in omitting the use of the cholera-belt, particularly at night. Of all forms of diarrhœa, it is, in my experience, the one most likely to develop into true dysentery. It often occurs among junior officers and young soldiers, who have not sufficient experience to appreciate the dangers of visceral congestion when serving in a hot climate.

Diarrhœa due probably to a Specific Organism.—As already stated, the occurrence of enteric in old-standing camps is generally preceded by an anomalous form of fever accompanied by diarrhœa, and it is this condition which I venture to place under the above heading. Taking the effect of apparent similarity of origin into careful consideration, it does not seem unlikely that this form of diarrhœa may be pathologically associated with true enteric fever, being possibly an attenuated form of the last-named disease. The theory of 'the progressive development of the property of infectiveness' already alluded to might well apply here, and, even if admitted as a mere hypothesis, such an admission must lead to measures of prevention likely to be attended with the most salutary results. There is also a form of diarrhœa which I have noticed as common among men whose duties consisted in the care of horses. I found it very prevalent among the Kaffirs in the remount stables in Durban. This appears to coincide to some extent with the view advanced by Waldo as to the connection between summer diarrhœa and 'the horse-dung which is daily deposited in vast quantities upon our highways.' The practical point of any such relationship as applied to the conditions of service is, of course, evident.

Simple Continued Fever

This term, without doubt, comprises more than one pathological condition. In many cases it is certainly a mild form of enteric fever, and most medical officers probably know of cases which have been diagnosed under the above heading, and which have subsequently developed venous thrombosis in a form which has left little doubt as to the nature of the original malady. The term 'simple continued fever' is also often applied to that febrile condition which arises in standing camps, and which is usually associated with diarrhœa. Its possible relationship, when appearing in this form, with enteric fever has already been discussed. As regards this question of relationship, it is to be noticed that the so-called simple continued fever of camps is often replaced by enteric fever, there being a general inverse ratio between the two. As enteric establishes itself, so simple continued fever, which is generally the precursor of the more serious illness, to a certain extent disappears. In 1885, in Egypt, the admissions for simple fever were in the ratio of 202·5 per 1,000, and in 1886, when there was an enormous increase in enteric fever, the ratio dropped to 164·3 per 1,000. The fact indicated above is suggestive as regards the possible relationship referred to, and in the future a careful record of figures in this connection would be both of practical and scientific interest.

When the disease supervenes on the line of march, where a source of infection can reasonably be eliminated, it is mostly due to direct exposure to sun. In this form I have constantly suffered from it myself, and I have generally found that lack of food in the

morning directly predisposes to its occurrence. The symptoms vary from a transient febrile disturbance to alarming hyperpyrexia accompanied by agonizing pains in the head. Vomiting may occur, but I have not found it a prominent symptom. The attacks, as a rule, are not dangerous, but they are very liable to recur.

As regards the possible relationship between enteric fever and so-called simple continued fever, it is of great interest to note that certain cases of continued fever, accompanied by gastro-intestinal disturbance, appear to be due to an infection by the colon bacillus, and in this connection I can scarcely do better than quote at length from an interesting editorial which appeared in the July number for 1903 of the *Journal of the Royal Army Corps*.

The extract in question reads as follows :

'One of the most striking features of modern literature upon enteric fever is the development of the idea that many of the cases which are clinically diagnosed to be enteric, and presumably caused by infection due to the bacillus of Eberth and Gaffky, are really instances of infection by the colon bacillus, or possibly by both it and the *Bacillus typhosus*, has gained ground, and is to some extent supported by scientific evidence. Certain cases reported by Burch in the *Medical Journal of New York*, May 31, 1902, to some extent bear out this view. His patients all suffered from continued fever, preceded by malaise, and invariably accompanied by some gastro-intestinal disturbance. The tongue was dry and foul ; the abdomen usually distended, with gurgling and pain in the iliac fossa. Headache and mild delirium were not unusual. Examinations of the blood showed a diminution of leucocytes, while the

urine swarmed with *B. coli communis*. With the Grüber-Widal reaction, he patient's serum failed to specifically affect the *B. typhosus*, though it did agglutinate the urinary bacilli. None of the cases apparently terminated fatally. Many medical officers in the army are familiar with cases of this kind. Clinically and pathologically they are indistinguishable from classical enterica, but bacteriologically they are not, as the sera are specific only to colon bacilli, while from the spleen and blood only these micro-organisms are recoverable. It is difficult to see why these cases should not be regarded as instances of a pure infection by the colon bacillus, for it is exceedingly improbable that all of these should fail to react to the enteric bacillus if in reality they were cases of typhoid fever.

'Similar in nature, and equally interesting, are other cases which have been recorded in recent medical literature, and in which the infecting agent would seem to have been organisms intermediate between the enteric and the colon bacilli, and which are variously termed para-typhoid or para-colon, according to whether they conform culturally to one or other type. There can be little doubt that in the detection, noting, and bacteriologically observing of cases of this kind, especially in India and South Africa, there is a large and promising field of work for army medical officers. The line of inquiry should embrace not only exact identification of micro-organisms recoverable immediately after death, but serum reactions of the patient against typical enteric bacilli, typical colon bacilli, and atypical varieties of both. At the same time, when the circumstances permit, the search should be made for bacilli in the blood, and precise identification estab-

lished of any bacteria found. Some important work in this direction has been done by Cole (*Bulletin of Johns Hopkins Hospital*, July, 1901) and by Schotmueller (*Münch. Med. Wochenschrift*, September 23, 1902), who both find the diagnostic and prognostic uses of bacteriological blood examinations more valuable than the Grüber-Widal test, since the former is able to allow of definite conclusions being formed before the latter. As compared with a bacteriological examination of the fæces or of the spots, the blood method has advantages. The front of the arm must be carefully washed with soap and water, then with ether, and lastly with bichloride of mercury solution (1 in 1,000). The bichloride is next carefully removed by means of sterile swabs of wool soaked in sterile water, and 10 c.c. of blood removed by inserting the sterile needle of a sterile syringe into a superficial vein. The contents of the syringe are quickly passed into agar which has been made fluid and cooled to 45° C., and the whole well mixed and plated. About 2 c.c. of blood should be added to each tube containing from 6 c.c. to 10 c.c. of agar. Besides the two observers named above, Courmont and Busguet speak well of this method, and, provided elementary care as to antisepsis be observed, it should present no risks to the patient incommensurate with its real diagnostic value.'

The above method, of course, necessitates practical knowledge of bacteriological technique, and the possession of certain apparatus. It is therefore scarcely likely that, for the present, it will become generally applicable.

The line of investigation, however, as stated above,

offers a field of great promise to medical officers in the army in cases, of course, where the necessary means and the necessary experience are forthcoming. Whatever the outcome of future research may be, the practical point for the military sanitarian remains unaltered —viz., that the polluted soil of camps is in all probability a direct causative agent in the production of such diseases as those at present under consideration, and the extract in question contains strong corroborative evidence of a close relationship between diseases which constantly arise under conditions referred to above.

Dyspepsia

The various forms of digestive disturbance which can be classified under the above designation present, as a rule, nothing which calls for special comment as regards field service. There are, however, in this connection two conditions which are worthy of attention. One is the absolute anorexia which frequently arises from a monotony of diet, and which I have noticed to be the precursor of enteric fever, although my observations are not sufficiently extended to enable me to say whether this relationship is a chance one or the reverse. That the condition in question is, however, often associated with diarrhœa is a fact concerning which my experience leads me to have no doubt whatever.

Secondly, there is a flatulent form of dyspepsia which I believe to be caused by the prolonged use of biscuit. Diarrhœa is a very frequent accompaniment.

As previously stated, the cause of the trouble admitted, as far as men on block-house duty were concerned, of a fairly ready remedy.

ENTERITIS

Although this term is a vague one, and has therefore no definite scientific meaning, it is the best that I can adopt for my present purpose. It might, of course, have been included under a previous heading, particularly as I think it extremely likely that the condition that I shall endeavour to describe is a virulent variety of what I have called diarrhœa, due probably to a specific organism. On account, however, of its practical importance, I have thought it would be well to consider it altogether separately from those allied conditions which have already been discussed. The statements which have been previously made as regards the influence of soil pollution on the production of certain diseases apply with special force in this particular case. There also appears to be a direct relationship between the degree of soil pollution and the virulence of the disease. Referring to previously-recorded experience in South Africa, I may state that neither at Estcourt, Spearman's Plain, nor Springfield Bridge, nor at any time on the line of march did I see a case to which the above designation could be fairly applied. It was at Chieveley in the month of February, 1900, that I first had practical knowledge of the condition in question. The camp was, without exception, the very filthiest that I have ever seen, and it had been more or less in occupation since the Battle of Colenso early in December, 1899. I do not mean to infer that sanitary conservancy had been entirely neglected—there was nothing in the way of unburied refuse to meet the eye—but continued occupation had practically removed all vegetation, destroying thereby natural means of puri-

fication, and reducing the place to a desert, while the presence of organic pollution in the soil was indicated by myriads of flies which swarmed in countless numbers over the ground.

As a rule, the cases referred to were shown in the official returns as dysentery, but in my experience they bore nothing like a close resemblance to that assemblage of clinical signs to which the above designation is applied in Egypt, in India, and in Oriental countries generally. Indeed, what is called dysentery in the East was not so common in South Africa as official reports appeared to indicate, the designation in question being made to comprise a fairly extensive variety of intestinal troubles. Whether what I have called enteritis is, as already fully admitted to be possible, merely an aggravated type of that form of diarrhœa which is, as previously indicated, the probable result of soil pollution, whether in consequence it is likely to be associated pathologically with enteric fever, or whether it is a disease *per se*, are not only matters of scientific, but also of great practical importance; but unfortunately the consideration of any such problems involves questions to which existing knowledge vouchsafes no satisfactory answer.

As a general rule, the attack shows itself as a rapidly progressive form of diarrhœa. The temperature may, or may not, be raised. The worst cases that I have ever seen showed no febrile symptoms. Diffuse pain over the abdominal region is common, but is generally relieved after each evacuation. The motions are copious, passed without straining, and followed by a sense of relief. Blood and serous fluid are, after a variable period, found in large quantities along with

the liquid fæcal matter passed by the patient. In the worst forms of the disease, the motions consist only of the first-named constituents. The quantity of blood-stained watery discharge which flows away from the bowels is extraordinary. There is nothing which suggests acute hæmorrhage from an ulcerated surface; the discharge seems to be more of the nature of a constant drain from disorganized capillaries. Vomiting may be present, and is, I believe, of unfavourable import; and the same may be said of the existence of albumin in the urine.

Mental depression is most marked; but although it is by no means always present, it occurs so commonly that I should be disposed to regard it as a leading symptom of a most serious morbid condition. Of course, a like circumstance is common enough in many forms of illness, but it presents in this particular connection characteristics which are rarely found among men in the prime of life, no matter what acute ailment may attack them. I have known both officers and men who were by no means emotional under ordinary circumstances, and who were noted for general smartness, to be rapidly reduced to a condition of lachrymose fatuity and self-pitying abandonment which it was most distressing to witness, and particularly so from the fact that this form of mental perversion was absolutely foreign to the characters of the same persons when in a state of health.

Considering all the symptoms collectively, and taking particular note of the fact that the mental condition may occur early in the attack, and that it tends to manifest itself to an extent altogether out of proportion to the other signs, it would appear not unlikely

that the disease consists essentially of some form of general poisoning of which the intestinal flux is only a symptom.

I should add that I have here ventured to dwell on the purely clinical aspect of the question, with the view of emphasizing the existence of a morbid state which I believe to be the result of the most grossly insanitary conditions. There is one extremely practical point of distinction between the above condition and dysentery as it is known in the East. In the former case the administration of ipecacuanha appears to be absolutely useless, while in the latter its value is too well known to be insisted on here. In South Africa I have succeeded in cutting short an attack of what I would venture to call true dysentery by the early administration of the above drug, but I found this method of treatment to be followed by no good results whatever when applied to the condition at present considered, and the same may be said of astringents generally. This conclusion is not hastily arrived at, but is based on a fairly extensive experience.

The administration of stimulants and the hypodermic injection of strychnine I found to be of great utility, facts which, taken in conjunction with the above statements relative to the inutility of certain drugs, tends to bear out the suggestion already made concerning the existence in this connection of some form of general poisoning.

As regards the influence of soil pollution, I may state that the experience at Chieveley was repeated on an extensive scale in the pestilential camps at Surprise Hill and Hyde's Farm, to the north of Ladysmith, and again at Glencoe, where the mortality ex-

ceeded any that I had previously witnessed. The localities last named had, as already stated, before their occupation by our own troops, been the site of Boer laagers, and, as was well known at the time, a zeal for sanitation found no place among the virtues of the South African Dutch.

Contagious Ophthalmia

As is well known, this disease exists in two distinct forms—firstly, as an acute suppurative conjunctivitis; secondly, as a granular conjunctivitis. While in medical charge of a company of mounted infantry, of which mention has already been made, proceeding up the Nile from Cairo to Wady Halfa, in the autumn of 1886, a severe outbreak of the former manifestation of the disease occurred amongst the men. Isolation was a matter of complete impossibility, and, speaking from memory, I think that nearly 50 per cent. of the force must at one time or other have been affected. The officers, of whom there were six, escaped entirely, although, of course, brought into constant contact with the sufferers. The space allotted to the men was, having regard to their numbers, extremely limited, and this, coupled with the fact that soldiers constantly use each other's towels and blankets, would account for the incidence of the disease falling heavily on the rank and file. I was much impressed with the highly communicable nature of this condition. It appeared to have originated from one man, who reported sick with purulent discharge from the eyelids the day after we left Cairo. As already stated, there were no means of isolation, and although I succeeded in transferring the

man ashore for treatment, the trouble had started, with the results that I have already named.

At Korosko, in the following year, we had several cases of the second form of ophthalmia. The infectivity appeared, however, to be much less marked in this case than in that of the outbreak referred to as occurring in the mounted infantry. These conditions appeared to arise independently of season, and were probably largely due to irritation from sand in the form of dust, which would help also to spread the disease after it had come into existence.

PNEUMONIA

Regarding this disease entirely from the clinical standpoint, and limiting the term for purposes of convenience to what is generally known as 'acute lobar pneumonia,' its causative agencies may, for practical purposes of military sanitation, be divided into three main headings—viz., dust, overcrowding, and soil pollution. Other causes, apart from the essential germ, notably exposure to cold, are, of course, well known, but full reference to these can be found in comprehensive books on medicine. At present the etiology of this condition is only regarded in connection with those matters which particularly claim the attention of the army medical officer. It would be, of course, more scientific to allude to the above agencies as 'predisposing' rather than as causative; but it should be understood that the latter term is used only as a matter of convenience. As an illustration of the effect of dust, I may cite the case of three battalions of militia which arrived at Colchester for their annual training in the

early part of the summer of 1889. One of these battalions was camped on a grassy plain known locally as the Abbey Field; the remaining battalions were located on a parade-ground within the precincts of the barracks. The weather was dry and hot, and consequently dusty. Although official or other records in this particular connection are not at present available, and although I am consequently writing from memory alone, the main circumstances of the case are vividly impressed on my mind. During the twenty-eight days' training, one case of pneumonia occurred among the men camped on the Abbey Field, while those on the parade-ground suffered severely. The troops of the regular army located in huts in the same barracks escaped entirely. The latter troops were three battalions strong. Exact numbers are not forthcoming, and this is, of course, a matter of regret; but in spite of this deficiency in evidence, the prominent fact remains that men camped on a dusty and probably polluted soil were attacked in a serious form by a malady from which other troops in the immediate neighbourhood were practically free.

The probable effect of soil in the production of pneumonia is less marked than in the case of dust. I never saw the disease in South Africa, but I have known it appear (although not to a serious extent) in Egypt under similar conditions as those detailed in connection with the causation of enteric fever.* It is of great interest to note in this connection that Wasden

* It is difficult to allot to each of the above agencies—viz., dust and soil pollution—its respective share in the production of pneumonia. It is likely that the essential cause may exist in the soil, and be disseminated by means of dust.

has suggested that enteric fever is frequently of pneumonic origin.

Overcrowding is a common cause of pneumonia, and I have known it break out badly on board ship among troops in hot weather. In this form it appears to be exceptionally fatal. It tends to spread rapidly in the confined space between the decks, and as isolation is a matter of difficulty on board ship, the problem presented to the medical authorities is one of considerable difficulty.

Speaking from experience, I believe that, with few exceptions, cases of infectious disease should be isolated on deck, and well aft. The latter rule, however, is not absolute, as, for instance, when outward bound for the Cape, and in the north-east trades, when it may be safer to place infectious cases in the bows. The same rule would apply when homeward bound, and in the south-east trades, or, of course, in the case of any following wind moving faster than the ship.*

Dengue

The symptoms and other features of this disease are sufficiently well known, and, in view of the above, its mention at present would scarcely have been called for if it had not been for certain difficulties in diagnosis, of which up to the present I have seen no record in medical literature. The following illustration of the difficulties may be of interest :

In the month of October, 1901, the men of Bethune's

* The health of troops proceeding on service appears to have a connection sufficiently close with conditions in the field to justify the introduction of the above remarks.

Column, returning from Zululand, were suddenly attacked by an acute febrile epidemic. The initial cases, as far as I can ascertain, occurred between the Tugela and the town of Stanger in Southern Natal. In this part of the colony dengue is of common occurrence, and the early symptoms which the men presented were typical of the disease in question. The appearance, however, of swollen glands in the groins and axillæ suggested the possibility of a more serious morbid condition. An isolation camp was formed at Stanger, and all communication with the civil population, except as far as was absolutely necessary, was prohibited.

These measures were effective in absolutely limiting the disease to the troops.

I was summoned by telegram from Zululand to proceed immediately to the above-named town and assume medical charge of the camp.

Before my arrival, a bacteriological investigation had been carried out by Major Beveridge, R.A.M.C., who had been sent from Pretoria for the purpose, and in the opinion of this officer the disease was certainly not what it was suspected to be—viz., a mild form of plague.

The symptoms such as I observed them were generally those of dengue, but without anything of the nature of a typical rash, and with the glandular swelling above mentioned added to the usual symptoms. The onset was identical with that which occurs in dengue, but the presence of the glandular swellings and the difference as regards rash were certainly sufficient to excite serious suspicion. The cases yielded to treatment readily, and the mortality was nil.

It was noteworthy that the outbreak occurred after

the troops had left the healthy and bracing uplands of Zululand, and had descended to the humid and relaxing atmosphere of the coast region of Natal.

The sudden occurrence of the disease after the troops had left Zululand, and the exceptional nature of the symptoms observed, are, I think, points worthy of record. On service accurate notes are a matter of difficulty, but it would certainly serve purposes of practical utility if in the future any such outbreaks were carefully recorded as to all essential features.

MALARIA

The relationship between malarial parasites and mosquitoes of the genus Anopheles has been, as is well known, placed on a solid foundation of scientific accuracy by means of many independent observers, notably Manson, Ross, Celli, and Grassi. In general terms, the life-history of the malarial parasite, which belongs to the class sporozoa among the Protozoa, is as follows :

The parasites are found within the red blood corpuscles, and occur in two forms—viz., sporocytes or gameto-cytes—the essential difference between these forms being that the former produce themselves asexually, and the latter sexually ; the sporocytes divide into spores, which become free in the blood, and attack fresh corpuscles, and so propagate themselves indefinitely. The gameto-cytes, after a variable time, are taken from the blood of the patient by the mosquito already referred to. In the middle intestine of the mosquito the corpuscles containing the parasite break down, and the latter are set free, and soon become ovoid or spherical. The male cells become flagellated,

and the flagellæ shortly break off from the parent cell, and make their way through the liquor sanguinis. In coming into contact with a female cell or macro-gamete, the moving flagella, or micro-gamete, unites with the nucleus of the former, and this act of union constitutes fertilization. The resulting body is termed a zygote. The zygote, having fixed itself on the parietes of the middle intestine, divides into eight to twelve portions, which in their earlier stages are known as zygotomeres, and later on as 'blastophores.' Each blastophore develops on its surface a number of spindle-shaped bodies known as zygotoblasts, which, when the zygote reaches maturity, entirely replace the blastophores. When the capsule surrounding what was originally a zygote ruptures, the zygotoblasts become free in the body cavity of the mosquito, and ultimately reach the poison glands, from whence they are discharged by the middle stylet of the proboscis into the blood of the victim whom the mosquito attacks. Here the blasts develop into the amœbulæ, which constitute the forms in which the parasite is observed in its earliest stages in the blood.*

The above, of course, is only intended as a very general idea of what is stated to take place. Full and precise information can be obtained from the works of Manson and of Ross. The practical point, as regards military sanitation, consists in the broad fact relating to the parts played by the mosquito in the development of this disease. Certain mosquitoes, it is well known,

* This brief outline of what is believed to take place is, in the main, borrowed from the admirably lucid account of the malarial parasite contained in the second edition of Professor Hewlett's 'Manual of Bacteriology.'

are harmless, and the above train of events is apparently confined to the genus Anopheles. It is a matter of considerable practical importance for the medical officer to be able to detect the latter, as its presence may be accepted as evidence of the danger, as regards malaria, of any given locality. There are two points which in a general way serve to distinguish Anopheles from harmless forms of Culex. The former exhibit spots along the anterior edges of the wings, and they fix on their victims with their bodies at a right angle to the point of attack.

Although these peculiarities are of great practical importance in serving to distinguish harmful from other forms of mosquitoes, they are not to be absolutely relied on, but they are sufficiently trustworthy to be regarded in the light of valuable danger-signals, and they require no trained powers of observation for their detection. The larvæ of Anopheles thrive in fresh-water ponds and streams, particularly those which contain algæ. They are also seen in water-butts, disused pots or kettles, or almost any form of receptacle of a like nature containing water. They are likewise found in iron water-tanks, such as are used in certain tropical stations. They cannot exist in sea-water. The adult mosquito, like the larva, is local in its distribution, although it without doubt attacks persons on board ships at a considerable distance from the shore. The above statement, therefore, as to local habits cannot be taken as absolute. In the Army Medical Reports for 1900 there is a very valuable report by Captain (local Major) F. Smith, R.A.M.C., on 'The Distribution of Mosquito Larvæ on War Department Lands in Sierra Leone.'

As regards the above question of locality, Captain Smith writes as follows: 'It may be assumed that the mosquito prefers to live near the water, on which it can deposit its eggs, and that it does not travel further than is necessary in search of blood-food. The dearth of insects in some parts of Free Town . . . in the dry season is most likely not due to their death, but to migration in the direction of the streams.'

I have seen myself houses in the tropics absolutely infested with mosquitoes, while others a few hundred yards distant were free from the presence of these pests. In the former the cause of the trouble was to be found in the presence of water—notably ponds, or collections of rain in dirty water-butts. It is in such surroundings that the larvæ find conditions particularly suited to their growth, and notably so, as already stated, when algæ are present. They exist also in running water, but they are not so noticeable as in the case of stagnant collections. Without going further into this particular matter, it is safe to assert that the general connection between the presence of water, of certain forms of mosquitoes, and of malaria, can be accepted with confidence.

Observers are divided in opinion as to whether the presence of the mosquito is absolutely essential to the production of the disease. Celli and Grassi hold that this is the case; but, on the other hand, there is good evidence that malarial germs may exist in the soil, and this possible fact affords an explanation of those cases of malaria which result from disturbances of the surface of the ground, apart altogether from the presence of mosquitoes.

There is strong evidence that water is one means of

spreading malaria. Captain Munson, of the United States army, records several cases of military posts which have been markedly improved as regards malaria by the purification of drinking-water.

The most classical case of the kind is that recorded by Boudin in connection with the transport *Argo*. One hundred and twenty soldiers embarked in this vessel at Bona, in Algiers, for Marseilles. 'During the voyage 111 of them, 13 of whom died, suffered from different forms of malarial fever. Two other vessels, carrying between them 680 soldiers, also from Bona, and arriving at Marseilles the same day as the *Argo*, had no cases of illness at all, and the only ascertainable difference of circumstances between the troops in these ships and those in the *Argo* was the difference of drinking-water. The latter were exceptionally supplied with water, which was said to have an unpleasant smell and taste, from a marsh near Bona; those in the other ships were supplied with good water. Finally, the nine soldiers on the *Argo* who escaped were said to have purchased wholesome water from the crew of the vessel.'

Although malaria is essentially a disease of low-lying districts, it is by no means confined to these, and it is stated to have been found at an altitude of 2,000 feet.

The distance to which the disease is carried over water is doubtful, and will probably largely depend upon the direction and force of the wind. In this connection, it is stated in the report of Captain Smith, above referred to, that 'at Forcados River mosquitoes were plentiful on a transport from the Cape within an hour of casting anchor, more than a mile off shore, from which a soft breeze was coming.' A remarkable case

which occurred in St. Helena is evidence of a striking, if not a conclusive, nature that mosquitoes may even be wafted over longer distances than the above. The case referred to was that of a well-known resident of the island, who at no time of his life had suffered from ague, and who had never, in all reasonable probability, been exposed to its influence up to the period of his return from a visit to England. According to his statement, the ship in which he was a passenger on the outward voyage, passed exceptionally close to the land while near Cape Verde—' so near that the passengers could plainly distinguish trees and human habitations.' Shortly after landing in St. Helena he was seized with a severe attack of ague, of the nature of which his son, who was one of the military medical officers doing duty in the island, assured me there was absolutely no doubt. This story is, of course, not in the least conclusive, but, as far as it goes, it is of interest as evidence of possibilities which are not devoid of extreme practical importance.*

The above by no means exhausts the list of diseases to which the soldier on service is peculiarly liable, but it comprises all those of which I have personal experience, and I have therefore thought it well to refrain from discussing matters concerning which I have no practical knowledge, and which are to be found fully set forth in standard medical literature by unimpeachable authorities.

* Malaria as an endemic disease is unknown in St. Helena.

CHAPTER III

ADMINISTRATIVE MATTERS AFFECTING THE HEALTH OF TROOPS IN THE FIELD

BELL-TENTS

THE tents of the British army are of numerous patterns and of varying degrees of excellence, but, whatever virtues the majority of them may possess, there is no doubt that the single-fly bell-tent, which so largely figured in South Africa, is, without exception, the very worst that ever was constructed. There is nothing in the shape of ventilation which is worthy of the name; the inlet for air consists of the door and also of the narrow space existing, when the flies are rolled up, between the edge of the canvas and the ground, and there are a few utterly inadequate apertures of exit near the top. The result of this arrangement is that the foul and heated air rises towards the apex of the tent, where, having no suitable means of exit, it must of necessity remain, its temperature being maintained by conduction from the heated canvas. The prone position is, of course, under the circumstances, the only one suitable for obtaining a due supply of air, unless the occupant or occupants elect to remain at the door. When the flies are down and the door laced up, there is no ventilation at all, and at such times the interior is

highly suggestive of a fœtid oven. It is true that a certain amount of air passes through the canvas, but the quantity that does so must be infinitesimal as regards the requirements of health ; and when the tent is wet with rain or dew, even this source of supply is cut off. Owing to the conducting powers of the canvas, the tent is a most inefficient protection against either heat or cold. This last defect is, however, partly remedied in the double-fly bell-tent, as the air between

Fig. 3.—*Single-Fly Bell-Tent, Flies Down.*

the flies impedes the conduction of heat, and therefore renders the interior cooler in the summer and warmer in the winter ; otherwise the same disadvantages are present as in the case of the single-fly tent. It must, however, be remembered that air is a conductor of heat, although its powers in this direction are comparatively feeble. It follows, therefore, that to obtain the best results as regards protection against heat in the double-fly tent it is essential that there should be an opening

at the top of the outer fly sufficient to insure a free current of air between the two layers of canvas. The interior of these tents rapidly becomes foul from refuse of all sorts which results from their occupation. Soldiers are well known to be careless about many common-sense precautions as regards health, and ordinary acts of cleanliness are frequently disregarded. Remnants of food, dirty water, and sometimes other

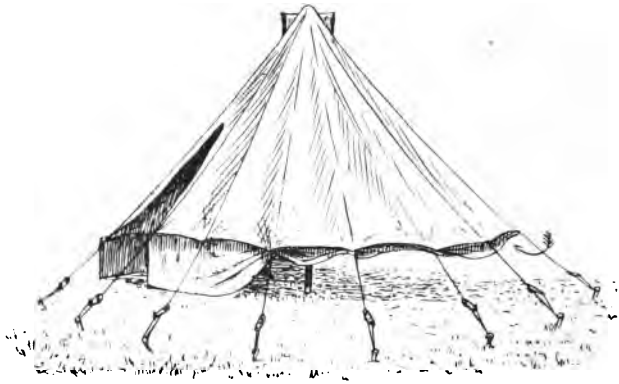

Fig. 4.—*Single-Fly Bell-Tent, Flies partially Rolled Up.*

Arrow indicates general direction of entering current of air. For practical purposes, the effect of the small openings at top of tent may be disregarded.

forms of pollution, reduce the earth forming the floors to a breeding-ground for microbes of all sorts. The flies are fastened down at night and in bad weather, and the occupants at these times are placed under conditions which, having regard to previous statements, would appear to be directly conducive to the production of disease, being a distinct aggravation of those already unfavourable circumstances which obtain when the only possible means of ventilation are made avail-

able. The absence of light also is an unfavourable factor as regards health, which should not be forgotten.

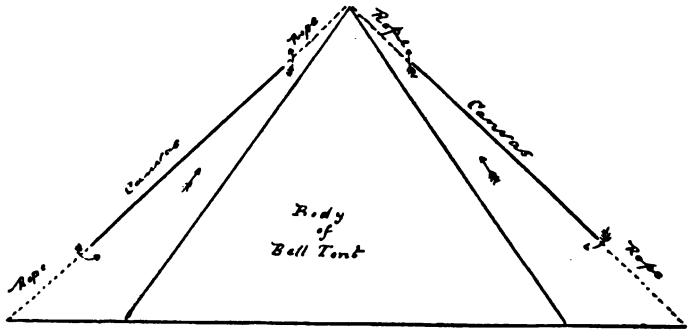

Fig. 5.—*Diagram illustrating Air-Currents in Double-Fly Bell-Tent, with Aperture at Upper Part of Fly.*

Arrows indicate direction of air-currents.

Sunlight, according to the researches of Downes and Blunt, has most distinct bactericidal powers. If plate

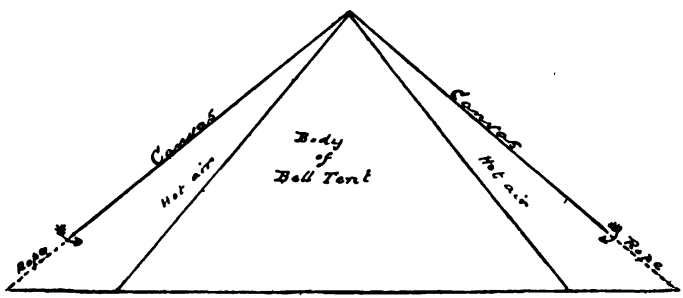

Fig. 6.—*Diagram illustrating Air-Current in Double-Fly Bell-Tent, with no Aperture in Upper Part of Fly.*

cultures be prepared and exposed to sunlight, a portion of the plate being covered with black paper, it is found

that the colonies only develop at the protected portion, that exposed to sunlight remaining sterile. How far the canvas of the tent would take the place of the black paper in the above experiment is a matter of speculation only, but it is reasonable to assume that it must have some influence in this direction, particularly in view of the everyday experience as to the necessity for light in the maintenance of health. To sum up the above generally: men occupying bell-tents are exposed to the dangers accruing from the following:

1. Defective ventilation.
2. Polluted soil.
3. High temperature.
4. Deficiency of sunlight.
5. Lack of cleanliness.

It is well known that these five conditions are most important in the production of epidemic diarrhœa, although this is by no means the limit of their sphere of influence. The above state of things is, of course, intensified when the tents are occupied by sick men, who remain more or less in one position during the whole twenty-four hours, and whose exhalations and possibly excreta render the stagnant air offensive to the last degree. It is a matter also of considerable interest to note that the largest of the tents, with an internal capacity of 672 cubic feet, will, according to a regulated scheme, accommodate fifteen soldiers or four patients.*

* 'Of the various forms of tent in use in the British army, either at home or abroad, perhaps the worst as regards healthfulness is the bell tent.' See Appendix IV., by Surgeon-Major J. Fleming, to A.M. Report, 1884.

Defective Means of Isolation

During the operations in Natal in the winter of 1899 and the early months of the following year every effort was made to classify the cases in the field hospitals as regards accommodation, but, owing to the very large number of sick, the attempt was only partially successful, so that men who had come to hospital with some more or less trivial ailment often found themselves placed in the ill-ventilated tents in the immediate proximity of patients suffering from one or other of the ailments which formed the scourge of the army of South Africa. That disease should spread under these circumstances is nothing to cause surprise, but the way out of the difficulty was at the time far from evident. The accommodation was limited, but not so the number of sick. To isolate men suffering from undoubted enteric fever and dysentery could not be done without causing overcrowding elsewhere, while the segregation of all cases the nature of which was doubtful was absolutely out of the question. The same tents were also used for a variety of purposes; for instance, a tent which in one camp might have been occupied by enteric patients was in another camp used for a totally different class of cases, or for the accommodation of medical officers or orderlies.

Hospital Attendants

The personnel of a field hospital consists of four medical officers, one quartermaster, and thirty-five rank and file. Each hospital is intended to accommodate 100 patients, but it often in South Africa accommodated 200 or more. The same orderly commonly had

care of some cases of enteric fever, some cases of dysentery, and a large number of other cases of a less important nature. It is not in the nature of things at all likely, although most carefully supervised, that the attendant who had just ministered to the wants of a helpless patient suffering from one of the above communicable diseases invariably cleaned his hands thoroughly before carrying out his duties in connection with other cases, such as the administration of food or medicine, or the application of dressings. The means for ablution in a field hospital are not extensive, and the result is that not only the hands and person of the sick attendant, but also the eating and drinking utensils, are liable to remain uncleansed, and constitute therefore a ready means for the spread of disease. From personal experience, I know that the hospital orderlies in South Africa worked admirably, and that their devotion to duty was beyond all praise, but, with a field hospital containing over 200 patients, many of them very seriously ill, and there being no adequate means of ablution, it was a matter of utter impossibility to carry out those details of cleanliness which have been named, and which are so essential for the safety of both sick and healthy.

Spread of Infection by Blankets

The blankets used by patients suffering from enteric fever and dysentery must constantly become soiled by the fæcal excreta and by the urine, and, as there are no means provided for disinfection in the field, the resulting danger is sufficiently obvious. From what has recently appeared in the public press, this danger is

now a matter of common knowledge. Thresh's portable disinfector was used in South Africa with excellent results in hospitals on the lines of communication ; but here, of course, the conditions were widely different from those prevailing amongst the medical establishments which accompanied the fighting force.

Spread of Infection by Clothing

During the operations in Natal before the relief of Ladysmith the sick in the field hospitals remained in their khaki during the whole period of their illness. It is certain that a large percentage of these patients were suffering from enteric fever, but I am not aware that their clothing at this time was ever disinfected. During the early spring of 1900 a considerable quantity of hospital clothing was distributed amongst the various field medical units, and improvised pack stores were established. Under the circumstances, it was impossible to maintain effectual separation between the clothing removed from men suffering from enteric fever or dysentery and that of other patients who had been admitted with ailments distinct from the above. In this connection, it is well to recall the fact that, according to the researches of Germano, the bacillus of enteric fever has been known to maintain its vitality in clothing for over a month.*

Spread of Infection by Stretchers

Stretchers were largely used in South Africa for the accommodation of the worst cases admitted to the field hospitals. As these cases consisted largely of one or

* *Zeitschr. f. Hyg.*, xxiv., 1897, No. 3, p. 403.

other form of communicable disease, it was a matter of importance to prevent contamination of the canvas of the stretcher. An effort was made to carry out this precaution by placing the regulation waterproof sheet beneath the body of the patient. There were, however, no adequate means of fastening the sheet, and, as it was constantly displaced by the movements of the patient, the object of the measure in question must very frequently have been defeated, and it would therefore

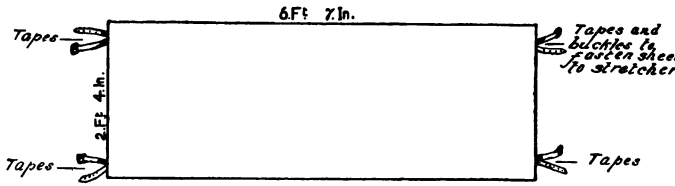

Fig. 7.—Adjustable Waterproof Cover.

Designed by the author to prevent contamination of stretchers. See note. Design was executed by Messrs. Evans and Wormull.

appear not unlikely that disease may have spread by means of infected stretcher canvas.*

A careful consideration of the above facts would appear to lead to one definite conclusion—viz., that the spread of sickness in an army in the field is in large part the direct result of attempting to carry out the treatment of serious cases in field hospitals and at the front, instead of in stationary hospitals at the base or on the lines of communication.

When we consider that in the United Kingdom enteric fever is a notifiable disease, calling, under legal

* An account of an adjustable cover, designed by me, to prevent contamination of the stretcher, will be found at p. 25, vol. i., *British Medical Journal*, 1903.

penalties, for certain clearly specified measures of precaution, we can form some idea of how far our field medical administration fell short of what modern views of preventive medicine indicate as essential to check the spread of infection.

It is true that dysentery, according to the provisions of the Infectious Disease Act, 1889, has not been scheduled as compulsorily notifiable, but the provisions of the Act in question have in some districts been extended to diarrhœa—a sufficiently elastic term—in which the first-named of the above conditions might easily be embraced.

There is every reasonable ground for believing that dysentery has not been included in the schedule of infectious diseases solely on account of the infrequency of its occurrence, and in no sense on account of the unlikelihood of its spread if it chanced to come into existence. The fact that diarrhœa has received even partial recognition as an infectious disease is in itself sufficiently suggestive.

I may add that previous statements concerning field hospitals are entirely the result of experience gained in South Africa. It should be scarcely necessary for me to explain that the statements in question contain no shadow of a reflection on that branch of the service to which I have the honour to belong. The presence of large numbers of sick in the field was partly the result of circumstances which could not possibly have been foreseen, and partly the result of certain conditions of service which will be dealt with later on. Every campaign is in itself an object-lesson of contingencies which cannot be provided for by even the most astute administrator, and recent events in South Africa consti-

tuted no exception to the above rule. Able medical administration saved us from disasters which would certainly have arisen under less capable management; and, having suffered severely from illness myself, I can testify from personal knowledge as to the admirable arrangements, made under most adverse circumstances, for the treatment and general well-being of the sick.

Latrine Trenches

The reduction of organic to inorganic matter in the soil is a fact of course well known, but, as already pointed out, the completeness and rapidity of the

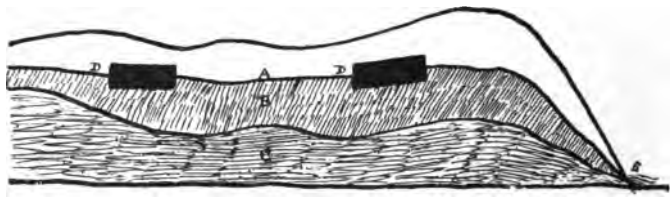

Fig. 8.—*Diagram showing Pollution of Ground-Water and Spring by Disused and Deep Latrine Trenches.*

A, upper level of ground-water; B, ground-water; C, impermeable stratum; D, trenches; E, spring.

change must depend upon the powers of certain organisms to carry out the process in question. These organisms, being essentially aerobic, are found in the upper layers of the soil only, and it is therefore unlikely that their influence will extend to the contents of latrine trenches dug several feet deep. The exact depth, however, at which the agencies referred to cease to be present can, in any particular case, only be a matter for conjecture. It seems reasonable, however, to assume that latrine trenches, such as I have often

seen dug fully 6 feet deep into rocky soil, are not likely to have their contents brought under the action of the vital agencies named above. Fæcal matter, under such circumstances, would probably undergo liquefaction in the same way that takes place when sewage is introduced into a septic tank. Perhaps, however, it would be better to compare the several conditions to those affecting a cesspool constructed without regard to the precautions against leakage which are called for in the light of modern science. Under certain circumstances, such a state of things is in the field a matter of no importance whatever, but it should never be lost sight of that liquid excremental matter might percolate through

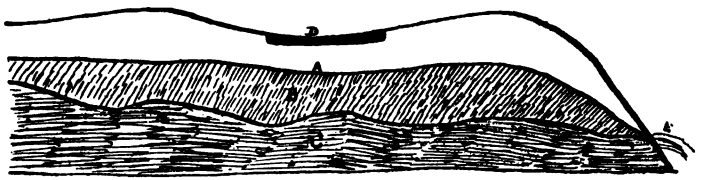

Fig. 9.—Diagram showing Shallow Latrine Trench well above Level of Ground-Water.

A, upper level of ground-water; B, ground-water; C, impermeable stratum; D, shallow trench; E, spring.

the interstices of the rock or through the soil, and would thus constitute a most serious danger to neighbouring water-supplies. In the case of springs or wells, it is impossible to know the area which any such may drain, so that the danger which has been pointed out above is something more than a theoretical one. When the ground-water has been opened up, the risk of contamination is particularly dangerous. In the case of shallow latrine trenches the reducing organisms should be able to effect a partial reduction, at any rate, to its

ultimate constituents of the organic matter which has to be dealt with; but, in view of the concentrated nature of the material in question, it is unlikely that the above task is always satisfactorily effected. In the case of filter-beds for the purification of sewage, great care is taken to insure the sewage being, as far as possible, of a uniform character, and also to allow fixed periods of rest to the organisms which carry out the change in question. Failing these precautions, the system is apt to break down, the sewage remaining in an unreduced or partially reduced condition. In the case of a camp, where these questions are not in the nature of things ever considered, it is only reasonable to assume that disused latrine trenches must contain for an indefinite period decomposing and offensive material of a nature dangerous to health. Whether, under the conditions named above of either deep or superficial burial, the ordinary intestinal bacterial forms are able to assume pathogenic powers, in a manner akin to that already suggested, is a question which at present admits of no definite answer. It is, however, interesting to note in this connection that Roux and Rodet are of opinion that the colon bacillus might, when grown in sewage, assume a pathogenic character, and give rise to a disease which is clinically indistinguishable from typhoid fever. Assuming, for the sake of argument only, that these observers are correct, we have a ready explanation of the constant advent, already dwelt on at some length, of enteric fever in camping-grounds which have been in prolonged occupation. The bacillus might either be washed by heavy rain, such as that which occurs in South Africa, into neighbouring water-supplies, or else be brought to

the surface by one or other of those means of soil disintegration which are constantly going on in every camp, and subsequently disseminated by dust and flies. To consider any such doctrine as the above to be proved is, of course, out of the question at present, but I think that, as a working hypothesis, it might be provisionally accepted, and it certainly receives considerable support from practical experience. At Kilworth Musketry Camp, of which I had charge during the months of August and September, 1899, the general health of the troops was in every respect excellent. The camping-ground had been in occupation during the whole of the musketry season, and, although one case of enteric fever occurred, it was conclusively proved to have originated elsewhere. Latrine buckets were in use, and refuse was regularly removed by contractors, the main sources of soil pollution being thus eliminated. At Tyger Kloof, in the Orange River Colony, where latrine buckets were introduced, and where refuse was removed absolutely from the precincts of the camp, enteric fever in the early part of 1902 was in my experience almost unknown, while Dyson's Farm, about five miles distant, was a hotbed of the above disease. The soil at the last-named post was absolutely saturated with filth, largely of fæcal origin. It is true that at Korosko latrine buckets were in use at a time when enteric fever was at its height; but this circumstance is of no value as an argument against the utility of refuse removal, owing to the fact that the improved system in question had not been introduced until the camp had been in occupation for many months.

I may here take the opportunity of emphasizing the fact that the medical authorities were in no way to blame

for delay in instituting this sanitary improvement in connection with the last-named station; full representations were made as to the necessity of the measure in question, but the necessary appliances were not available. The influence of fæcal pollution of the soil is, of course, by no means limited to enteric fever, but appears to extend to those general conditions of ill health resulting from the contamination of camping-grounds which have already been dealt with at some length, and whose manifestations generally exhibit themselves under the form of intestinal disorders.

It is of particular importance to note, as regards the influence of latrine trenches on health, that any basic nitrates formed from organic matter percolating from the trenches into the surrounding soil would constitute a medium in which, as is well known, the enteric bacillus can exist for prolonged periods. This fact as to the influence of nitrates on the life of the *Bacillus typhosus* has already been alluded to under the heading of Enteric Fever.

Aerated Waters

These are a serious source of danger. Bottles are returned to the manufactory after having been put to all sorts of purposes (I have myself seen these bottles used for the conveyance of urine which was to be tested); and as manufacturers gladly pay for all bottles brought to the factory, the danger which follows is obvious. A large supply of aerated water also is taken by hospitals, and the bottles handled by patients suffering from a variety of diseases, including enteric. I know also of one case where, although the water from which the

beverages were made was pure, that used for washing the bottles was obtained from a most dangerous source. The danger is particularly great in the field, where hawkers of all sorts follow the army.

Berkefeld Filters

Unless these are periodically sterilized—not less frequently than twice a week—they become not only useless, but a source of harm, as arrested germs may be forced through the apparatus by water undergoing filtration, and as long as germs are in the filter, so long will this danger be present.

Water-Carts

If these are once contaminated with impure water, they may impart disease-producing powers to any supply of pure water with which they may subsequently be filled. Badly-fitting lids are another source of danger, as, if the carts are kept near the horse lines, or, indeed, anywhere in the camp, organic dust is extremely likely to effect an entrance, with possibly serious results.

Men's Water-Bottles

It is well known that these are filled from all sorts of questionable sources, so that the danger indicated as regards water-carts applies here with equal force.

Refuse Disposal

The remarks made in connection with latrine trenches would, in a general sense, apply also to refuse disposal. The question will again be considered under the heading of Sanitary Measures.

Prolonged Occupation of Camping-Grounds

This matter has already been discussed at some length under former headings, and therefore need not be further referred to here.

Without repeating minor details, it would appear from the above that the principal causes of an administrative nature which affect the health of an army in the field are as follows :

1. Prolonged occupation of camping-grounds.
2. Presence of sick at the front.
3. Inadequate means of disinfection in the field.

No. 2 is, at any rate, in part, the direct result of the present limited powers of the medical service of the army as regards sick transport, and, in view of its importance, this part of the subject may be considered separately.

Sick Transport

Having regard to the general administration of a field hospital, an administration which cannot be reorganized without altering the essential nature of the unit in question, it would appear to be a matter of the very highest importance in the interests of general efficiency that all serious cases, and notably cases of communicable disease, should be removed with all possible speed from the neighbourhood of the fighting force. It is impossible at the front to carry out either segregation or disinfection with any degree of efficiency, and it thus becomes apparent that large numbers of sick, many of them suffering from ailments of the nature above referred to, notably enteric fever, become

a source of actual danger to the success of any army in the field, without taking into consideration results accruing to the patients themselves. Ready removal of sick to the base was, owing to the large numbers to be dealt with, a matter of impossibility in South Africa, and this question involved a variety of other considerations besides those of hospital accommodation. Among these considerations, the subject of transport occupied a prominent place. Sick were sent down from the force at Potgeiter's and Trichard's Drifts in January and February, 1900, in empty supply waggons, when such were available. If the War Office could have seen its way to placing the necessary means absolutely under the control of the medical authorities, there is no doubt that the resulting rapid removal of the sick from their unfavourable surroundings would have been a measure of the highest value. As it was, the medical department remained largely dependent on another branch of the army for a service solely connected with matters of hospital administration. The object-lesson presented in this connection by the events which occurred during the Natal Campaign affords a most powerful argument in favour of giving the medical service of the army complete autonomy in matters relating to its own transport. It certainly appears somewhat anomalous that the well-being of patients in field hospitals in such a vital matter as that in question should depend upon authorities who, in this particular connection—*i.e.*, deciding as to the necessity for the removal of sick and wounded—incurred no responsibility whatever.

CHAPTER IV

SANITARY MEASURES IN THE FIELD

In dealing with questions of sanitary measures in the field, reference must occasionally be made to those administrative matters with which the former are connected, and if repetition is here observable, I must apologize for it on the ground that I preferred to run such a risk rather than to fail in making my meaning as clear as I possibly could. I may also add that I have omitted the mention of certain sanitary measures which are matters of common knowledge, and concerning which there is no diversity of opinion.

I have refrained from formulating any recommendation regarding antityphoidal inoculations, as I did not feel justified in doing so, in the absence of fuller information than that which I possess. I may, however, state that, as far as my own experience goes, the protection afforded by this procedure is far from absolute; but it is only fair to add that I do not know of a single instance in which the second inoculation recommended has been given. There is strong statistical evidence that the case mortality and the incidence of the disease are each greatly lowered amongst those who have been inoculated,* but only time and experience will show

* *British Medical Journal*, 1902, p. 75; *Lancet*, 1902, p. 964; Army Medical Reports, 1900.

the actual value of the measure in question, and the conditions under which it is called for.

In cases of enteric fever occurring among the inoculated, it is a matter of great importance to ascertain and record the period which has elapsed between the date of inoculation and the subsequent attack.

I have not considered it necessary to dwell on matters fully set forth in the regulations, including troopship sanitation, which latter has already been incidentally mentioned.

Inspection of Men as to Fitness for Active Service

The official regulations for the examination of recruits comprise all essentials as to physical conditions requisite for efficiency as a soldier in any part of the world.

Subsequent examinations as regards fitness for active service are conducted with a view to ascertaining disabilities which may have been contracted by the soldier since he originally joined the colours. This is a matter of comparative simplicity, as, apart from manifest defects, the medical history of each man contains evidence of past illnesses, which may have left no apparent trace, but which would disqualify for service in the field. When, however, men who rejoin from the reserve come up for examination, the matter presents considerable difficulties. During the recent war in South Africa, when the public service was working at high pressure, the examination of reservists was largely carried out by civilian practitioners, whose lack of experience of the ways of the soldier led them

in many cases to pass men who were hopelessly unfit for the fatigue and exposure of a campaign. In their anxiety not to be excluded from participation in the struggle in which the army was about to engage, men on the reserve constantly concealed the existence of ailments which were an absolute bar to their re-employment as soldiers. This form of deception, while reflecting credit on the courage and patriotism of the men, was certainly not conducive to military efficiency. Many such cases were detected on board ship, and these men never arrived nearer the front than Cape Town or Durban. Others succeeded in getting up country, but broke down hopelessly under the physical strain to which they were exposed. During the march of the Fifth Division from Estcourt to the Tugela, the old soldiers who had suffered from ague and rheumatism were among the first patients to fill the field hospitals. It seems only reasonable to assume that the above state of things might—at any rate, to some considerable extent—have been avoided if the medical-history sheet had in all cases been forthcoming when the reserve men were examined. Such a plan would no doubt have increased the labour of an already heavily-worked administrative department, but the result could scarcely have failed to have been beneficial. A series of entries for 'ague,' 'disordered action of heart,' 'rheumatism,' and the like, would have insured the rejection of many whose presence in the field was a direct source, not only of inconvenience, but, by hampering administration, of actual danger to others. An estimate of the physical requirements for active service is a matter of ordinary commonsense; the difficulty of examining men in this con-

nection consists in ascertaining whether each individual fulfils the standard of these requirements or not. Part of the necessary evidence can be obtained by the usual methods of examination, and part by direct question and answer. In such cases as these under consideration the latter method, in the absence of documentary evidence, is not to be relied on, particularly when the examination is conducted by a civilian practitioner, who, no matter what his professional attainments may be, is unable, from want of experience, to elicit information of great value, but which the old soldier, when it suits his purpose, is well able to keep to himself.

It seems, therefore, a matter of considerable practical importance that the examination of medical-history sheets should, in this connection, be in all cases scrupulously carried out.

The work of the medical officer in the field is of a sufficiently arduous nature when he is only called upon to treat cases which are the direct result of the campaign. When, however, a share of his attention has to be directed to the care and treatment of chronic ailments, the men who have the first and most legitimate claim on his services are apt to suffer.

Space in field hospitals is limited, and overcrowding, it is scarcely necessary to state, is as far as possible to be avoided. It may be accepted as a general principle that disease and overcrowding go hand in hand in the field, as elsewhere, and the insanitary nature of bell-tents can scarcely fail to accentuate the evil effects which result from the aggregation of numbers of men in restricted areas, such as that of a field hospital or bearer-company camp. There is thus every good

reason why non-effectives should be kept out of the field, and to effect this object the measure here suggested as regards men's medical histories would in all probability prove of the highest utility.

Camping-Grounds which should be Avoided

In view of previous statements, it is hardly necessary to emphasize the necessity of regarding the question of soil purity as a leading factor in determining the site of a camping-ground. Apart from the manifest traces left by troops in any given locality, an indication of the existence of soil pollution, the result, probably, of recent occupation, may be found in swarms of flies attracted to the spot in search of food in the shape of offal and refuse generally. The importance of the presence of flies as a danger-signal pointing to the existence of organic filth was brought before me as a forcible object-lesson many times during the recent war. Of course, it is no argument to say that, because flies like polluted soil, polluted soil is invariably the cause of their presence; but it is perfectly fair to consider their presence in any locality as strongly suggestive of pollution, particularly when taken in conjunction with general signs of recent occupation. A place where these signs are present should, if possible, never form a site for a camp.

Dry and dusty soils, on the one hand, and, on the other hand, those which are unduly humid, or in the immediate proximity of water, should, when possible, be avoided. Dust, when coupled with soil pollution, can scarcely fail to spread disease, and apart from all other reasons, this would be quite sufficient to warrant the above precaution. The main reason for avoiding

the immediate neighbourhood of water is discussed in connection with malaria. The general indications for the choice of a camp are so well known that they need not, in common with other familiar matters of sanitation, be further dwelt on here.

Avoidance of Soil Pollution

The ideal method of avoiding the evil effects of polluted soil is to constantly alter the position of camps; but as the occasions which admit of this step are most infrequent, careful attention must be paid to other measures of a more generally applicable nature. In this connection the following are worthy of particular attention: (1) Tents; (2) latrines; (3) camp refuse.

1. *Tents.*—The tendency for the area of ground covered by a tent to become rapidly foul has already been discussed. It is a good plan to constantly change the position of individual tents, in order to give full play to the purifying agencies of nature—viz., air, sunlight, and the vital agencies of the soil. The two former must be inhibited in their action, the canvas constituting a screen, as long as a tent remains standing, and the latter are apt to be overtaxed by the constant additions to the organic material with which they have to deal. The presence of the last-named mainly results from those fragments of food, liquids of various sorts, and odd scraps of refuse, which pollute the soil of nearly every occupied tent. When general conditions are favourable, it is an excellent plan to have the tent struck daily, and left down for as many hours as possible.

2. *Latrines.*—When land is plentiful, and the necessary labour available, shallow latrine trenches, not more

than 1 foot deep, should be dug and filled in daily. Latrines of this sort should always be established by columns halting for the night, or even for a few hours. Some of the filthiest ground that I have seen in South Africa was where mid-day 'outspans' had been made day after day by different bodies of troops. The shallow trench is the one which approximates artificial disposal of refuse most nearly to the conditions of nature, as it puts the excreta in the most favourable position to take part in the eternal cycle of change by which organic is converted into inorganic matter, and the latter taken up as food for the vegetable world. At the beginning of the twentieth century the advice given in this connection by Moses to the Israelites cannot be improved upon.

The object of the shallow trench is both to bring the excreta well within the influence of reducing organisms which are only to be found in the upper layers of the soil, and also to limit the quantity of material to be dealt with in order to avoid placing too great a strain upon the powers of the organisms in question.

When both land and labour are limited, latrines may be dug as deep as possible, having, of course, careful regard to the possible danger of fouling neighbouring water-supplies. What, in default of a better term, may be called latrines of medium depth should as a rule be avoided. Their contents are in too great bulk to undergo the change to inorganic matter with satisfactory readiness, besides being placed beyond the immediate influence of the organisms upon which the process depends; and, as fresh latrines have constantly to be dug, the soil becomes absolutely soaked with filth of fæcal origin.

It has been pointed out to me by Lieutenant-Colonel Cottell, R.A.M.C. (retired), that when seats are not available, the latrine trenches should be dug narrow, so that the men can straddle across them. The suggestion is an excellent one. In the absence of seats, an instinct of self-preservation prevents the men who first use the trench from approaching sufficiently close to fulfil the requirements of sanitation. Those who come later keep further and further away, until the spot is absolutely unapproachable for reasons which are obvious to even the most casual observer.

Far better than any form of latrine trench is the bucket system for the disposal of excreta. Unfortunately this system is not generally applicable, owing to the labour necessary for the removal of the buckets, and also that the latter are not readily available in the field. Where possible, it is better to keep the buckets half full of water, or, better still, a solution of carbolic acid, rather than to use dry earth. Soldiers are very careless, and the use of the earth is often neglected, or the requisite quantity is found to be wanting. The buckets should be removed once or twice a day, according to circumstances, and the contents applied to the soil in the manner, if possible, indicated as regards shallow latrines; if this cannot be done, the excreta should be buried deeply. The destination should in all cases be as far from the camp as possible.

The following extracts from the Annual Report for the year ending June, 1889, of the Surgeon-General of the United States Army to the Secretary of War are of interest as bearing on the question of the removal of excreta in camps: 'During the movement of an active campaign, when a camp site is abandoned after an occupation of a few days, well-cared-for privy-pits

afford a simple and satisfactory means of disposing of the excreta of the command.

'When, however, the camp is one of some permanency, as is usual with camps of organization, recuperation, muster, or territorial occupation, the danger from the use of this primitive system of conservancy is proportional, other things being equal to the size of the command and the duration of its continuance on the same ground.

'With cases of typhoid fever, dysentery, or camp diarrhœa among the troops, the pits become foci of infection, which make their influence felt throughout the whole camp. . . . To preserve the health of the men in these camps, it is necessary to disinfect and remove the excreta.'

3. *Camp Refuse.*—Refuse should be removed from the camp and burned, if possible, or, if not burned, then buried in the same manner as the contents of the latrine bucket. Rubbish in many of the camps in South Africa was burned everywhere and anywhere, a proceeding that constituted a most horrible form of nuisance, the very food tasting of this smouldering filth. A burning rubbish-heap having proved one of the worst possible kinds of annoyance usually smouldered out, after which the unburned remnants were blown about the camp. I would here venture to place on record an experiment which I made in Aldershot last winter in the shape of an improvised camp refuse destructor. It consisted of two short trenches about the depth of those of an ordinary camp kitchen. These trenches intersected each other at right angles, and a chimney made of sods of earth was built over the angles of intersection. A few pieces of iron hooping supported the chimney where it crossed the trenches.

A fire was lighted at the base of the chimney, and the rubbish thrown down the top. The addition of a little turpentine to the rubbish helped matters immensely. There was a very fair draught through the trenches and up the chimney, and if the rubbish was put on with ordinary care, the fire generally burned itself out. The higher the chimney, of course, the better. This plan is far from a perfect one, but it has, nevertheless, certain advantages. It insures the rubbish being burnt in one place, and therefore mitigates what is often a most

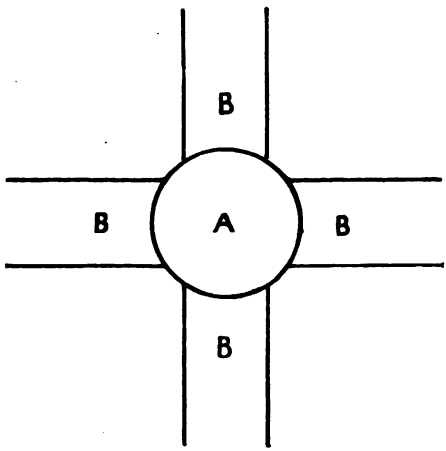

Fig. 10.—*Diagram of Author's Improvised Refuse Destructor.*
A, chimney (horizontal section); B, B, B, B, trenches.

serious nuisance; and there is no doubt that the process of destruction is more complete than when an attempt at burning is carried out in the open.

When one can be obtained, an ordinary navvy's devil makes a very fair camp refuse destructor.

There are, of course, a variety of specially-constructed refuse-destructors for use in camps, but such means are far from generally applicable on field service, so that improvised methods have to be resorted to.

Control of Manufactories for Aerated Waters

These in war-time should certainly be placed under military control. The dangers occurring from the use of aerated waters have already been pointed out. I know of one case in particular in which a soda-water manufacturer contracted to supply a large hospital on the understanding that the bottles were to be returned. The same manufacturer supplied not only a town, but an extensive district, and, as the bottles which were sent to the hospital, where a very large number of enteric cases were under treatment, were refilled on their return, and sold both to soldiers and to the general public, a wide field of 'pathogenic possibilities' was opened up. It may be too much to expect that every hospital should carry out the sterilization of all bottles likely to carry infection, but sterilization should certainly never be omitted before refilling. How long the *Bacillus typhosus* can live in aerated water appears to be a matter of uncertainty. In the last edition of Professor Hewlett's 'Manual of Bacteriology' it is stated that 'in aerated (CO_2) waters it does not survive a fortnight.' It may be inferred, therefore, that there is ample time for the production of the most serious mischief.

Soda-water bottles with indiarubber rims are a source of danger, as the indiarubber is ruined if sterilized by heat; there is, therefore, an additional reason why these bottles should never be sterilized at all. The ordinary cork may of course carry infection, but there is no great likelihood of its doing so, as it is generally thrown away after use. When in charge of a

hospital for infectious diseases, I directed that all bottles for aerated waters, after use in the wards, should be filled with a solution of izal, and left in a tub containing the same, until they were returned to the contractors.

SHELTER

It is impossible to formulate recommendations as to shelter which will meet all the varying requirements of

Fig. 11.—*Convalescent Camp, Harrismith.*

The photograph shows up in a graphic manner the contrast between European privates' tents (which are in the foreground) and bell-tents. The walls of the former can be removed to any desired extent.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

service in the field. The best that can be done in this direction is to set forth certain general principles which admit of wide application. When possible, huts should be utilized in lieu of tents, and the bell tent is about

the worst possible. The disadvantages of the latter have been fully dealt with, and, speaking personally, I can safely say that I have never, while in the field, suffered any particular inconvenience when these tents have been absent. The mountain service tent, on the contrary, is without doubt a source of great comfort, and is particularly to be recommended for use in field hospitals. I have seen the sick treated in each of the above forms of tent, and the advantages of the

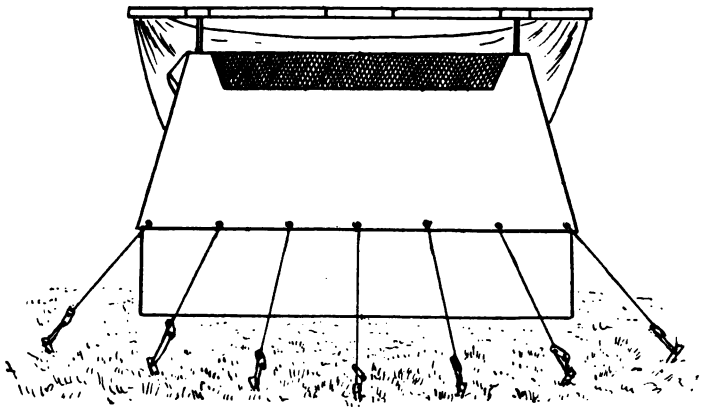

Fig. 12.—*Munson Hospital Tent, semi-diagrammatic.*

latter are too manifest to call for discussion. The hospital marquee and European privates' tents are both excellent; unfortunately, they cannot be pitched with any particular readiness; this disadvantage does not apply to the bell tent. The ease with which the latter is pitched and struck is about the only virtue which it possesses.

An excellent tent for hospital purposes appears to be that designed by Captain Munson, of the United States Army, a fully illustrated description of which appears

in his recent work on 'The Theory and Practice of Military Hygiene.'* 'The tent in appearance closely resembles the eighty-pound tent used by officers in India. The outer fly is enlarged and raised upon a light, false ridge placed 1 foot above the true ridge. The canvas comprising the top of the tent, under the outer fly, is cut out for a space 2 feet wide on each side of the ridge, and running the entire length of

Fig. 13.—*Men's Corrugated Iron Hut at Olivier's Hoek.*

The hut was built by the Farrier Sergeant, 62nd I.Y.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

the tent, except 1 foot front and rear. The canvas thus removed is replaced by heavy rope netting, having a mesh 2 inches square.'

The tent-fly is white in colour, while the tent itself

* 'Munson's Theory and Practice of Military Hygiene.' London: Baillière, Tindall and Cox.

is drab. Six patients are usually allotted to this tent, but more may be safely placed in it, owing to the free ventilation. It was found in Cuba that Munson's tent was from 7° to 10° cooler than the regulation tent for hospitals, and from 10° to 18° than the conical wall tent.

In cold weather the tent was made as snug ' as the old tent by merely placing an ordinary fly over the true ridge and under the large fly, and pegging it down so that the smaller fly rested against the tent roof, and thus closed the large ventilating opening.'

As before stated, huts should always be preferred to tents. In the Nile campaign we used huts constructed of sun-dried brick, with roofs of palm-branches. They were an excellent protection against the heat of the sun. Canvas, on the other hand, is a very poor protection, unless flies are provided for the tents with adequate means for free passage of air beneath the canvas of the flies and that of the body of the tent.

The following extract from a report from Manzanillo, Cuba, March 11, 1899, by Inspector-General Breckinridge, is of great interest as showing the differences of temperature in tents and buildings :

Hospital (brick building and tile roof) ..	81° F.
Officers' quarters (wooden building, tile roof, shades over windows)	81° F.
Barracks (wooden building, zinc roof) ..	84° F.
Barracks (wooden building, thatched roof)	83° F.
Ordinary tent (without floor)	90° F.
Hospital tent (with floor)	91° F.
Libley tent (with floor)	96° F.

Huts of corrugated iron, with a lining of wood, can be readily put up, and for this purpose no particular

Fig. 14.—*Officers' Corrugated Iron Hut at Olivier's Hoek.*

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

Fig. 15.—*Officers' Mess Hut with Veranda at Olivier's Hoek.*

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

skill is required. I have seen these huts in many camps in South Africa, notably Olivier's Hoek in the Drakensberg, and Fort Prospect in Zululand. If a space of a few inches is left between the wood and the iron, the air which circulates in this interval, acting as a non-conductor of heat, keeps the huts cool by day and warm by night. In order that the air may be allowed free movement, this space should not be closed in. Felting should be placed, when possible, between the wood and the iron, but this measure is not essential for purposes of comfort and health. Verandas are a great improvement, and should always be constructed when possible. Different forms of these huts, with and without verandas, are shown in accompanying photographs. These structures were erected by the officers and men of the Manchester Regiment and the Imperial Yeomanry, without any specially skilled assistance.

The Control of Sick Transport by the Medical Authorities

If the statements made above in connection with the presence of sick in the field are accepted as generally correct, it follows that the early removal of such men from the fighting-line becomes a matter of prime importance.

Apart from certain military exigencies—such, for instance, as the provision of a suitable escort in a savage country—this question of removal is one which should be decided by the army Medical Service alone, and, provided always that other conditions comprised, as above, under the general term of 'military exigencies,' are favourable, the necessary means of carry-

ing out this service should, as a matter of reason and justice, remain in the hands of those who are mainly responsible for its efficient execution, and who are alone competent to give expression as to its necessity.

It is not suggested here that every isolated unit should have separate sick transport; any such proposal would be impossible of execution. Circumstances

Fig. 16.—*Ambulance Crossing Drift near Tweefontein.*

The photograph shows the number of animals required on service for ordinary sick transport, and illustrates, therefore, the necessity for economy in this respect.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

alter cases, and it is not possible to formulate a scheme likely to meet all the requirements of field service. The only point insisted on here is the necessity for the acceptance of a general principle of autonomy in the direction indicated.

In speaking of sick transport, I should make it clear that I do not refer to the ambulances attached to bearer companies and field hospitals; these methods

of sick conveyance, being intended for use at the front, should not be taken away from their units for the purpose of conveying men long distances down country.

The difficulties of sick transport during the Natal campaign were followed by far-reaching consequences. At a time when the relief column was on the line of railway, and that ambulance-trains were frequently running, it was found impossible to evacuate the field hospitals, owing to the congested condition of the hospitals at the base,and on the lines of communication.

The following may serve as a possible explanation of the above fact:

It was about the middle of the month of February, 1900, that the troops who had been engaged in the hostilities at Spion Kop and Vaal Kranz returned to the line of rail at Chieveley. By this time enteric fever was rife in the force, the disease having been present to a greater or less extent since the latter part of the previous month. It thus becomes a question as to how far the base hospitals would have answered all requirements had the earlier cases of sickness been removed from the front. It is impossible to speak on this matter with absolute certainty, but it is not unreasonable to assume that such a measure would probably have had a most favourable effect in checking an epidemic of serious dimensions. The circumstances which there is good reason to consider as unfavourable to the above course have, I believe, been justly indicated. Without going into further details, the measure which these facts would seem to justify is the complete control, with certain common-sense reservations, of means of sick transport by the Medical Service.

The Medical Services of Canada have their own

transport, so that the idea suggested is not altogether unpractical. The transport section of each field hospital consists of twenty-one men — drivers, collar-makers, etc. These men are trained to act as orderlies when required. By means of an ingenious arrangement, some of the waggons are adapted both for the conveyance of sick and wounded and also for ordinary transport. An enormous advantage is, of course, gained in general efficiency by economy of transport. These waggons were designed by Colonel J. L. Neilson, Director-General of the Medical Services of Canada.

An address delivered by Colonel Neilson at the eleventh annual meeting of the Association of Military Surgeons of the United States, on the subject of ambulance and transport vehicles of the 10th Field Hospital of the Canadian Army Medical Services, is of great practical value, and will well repay careful perusal.

Isolation in the Field

Although actual removal of any cases of disease which are in the least likely to spread is the ideal measure of prophylaxis for a force in the field, such a radical procedure as that in question cannot be invariably carried out under the constantly changing conditions of active service, and other means have to be resorted to for checking infection.

It has already been pointed out that in field hospitals the same tents were used in the South African campaign for a variety of purposes, and it seems reasonable to assume that such a circumstance was not unlikely to encourage the spread of many forms of disease.

Owing to the very large number of sick to be dealt

with, it was a matter of impossibility to segregate or to set aside tents for the treatment of special cases. Under more favourable conditions, or, in other words, had the pressure on the administration been less, the provision of a few isolation tents, with distinguishing marks, would, in all probability, have proved to be a measure of great utility in limiting the dissemination of those diseases with which we were chiefly called upon to deal. Each of such tents, in addition to a distinguishing mark, might be furnished with a complete set of the material necessary for the treatment of severe cases. All such material, which would include close-stools, urinals, etc., should be plainly marked, so that none of it could in error be utilized for any other cases than those for which it would be intended. Such means of isolation as those indicated above would, under circumstances of warfare, only be likely to meet with very partial success, but even partial success would be worth having, and the measures referred to would, at any rate, act as a useful object-lesson in emphasizing the danger of retaining cases of certain forms of sickness in the neighbourhood of the fighting force. There is no doubt also that most effective isolation can, under certain circumstances, be carried out, even among mobile bodies of troops. The instance already referred to of the outbreak of dengue among the men of Bethune's Column is a good illustration of the above. In this case, the isolation camp was established about half a mile from the town of Stanger, and, by means of a cordon of sentries, all communication, as previously stated, except what was absolutely necessary, was cut off between the troops and the civil population. The results of this measure were in every way satisfactory.

The sick of the column being isolated, the main body continued its march to the Orange River Colony, and this separation, as far as I have been able to ascertain, was effectual in checking the rapid spread of a malady which threatened to temporarily incapacitate a body of troops whose efficiency at the time was a matter of exceptional importance.

WATER

The choice of a water-supply is largely a matter of common-sense, and depends on principles which are well known, and which have been fully discussed.

The question of purification, however, is one concerning which there are considerable divergencies of opinion. To boil water for drinking purposes is, in the field, not a measure likely to lead to satisfactory results. Either the firewood gives out or the administration breaks down. Up to the present there has been no special apparatus in our army for this service: camp-kettles are required for other purposes; men grumble at the extra labour thrown on them, with the consequence that the duty of carrying out the measure is shirked as far as possible by subordinates; and lastly, if the supply of boiled water is exhausted, the soldier will not wait while a fresh supply is prepared before quenching his thirst. All these disadvantages are obviated by recourse to the Berkefeld filter, but certain precautions are necessary in its use. Gross sediment must be got rid of by preliminary straining, as otherwise the candles become rapidly choked. It is also essential that the candles should be sterilized at least every third day in boiling water; great care

should also be taken to carefully inspect the candles to insure the absence of flaws, and the filters must be worked by trustworthy men of cleanly habits.

I distinctly remember seeing at Glencoe (Northern Natal) a soldier who had been put in charge of one of these filters drinking out of the outlet pipe, which he had placed in his mouth for the purpose.

Boiling the water after filtration is an additional safeguard, in the event of the sterilization of the candles having been from any cause omitted. Such a step would, however, only be called for on rare occasions.

It is perfectly clear that neither boiling nor filtration will, as a rule, affect chemical poisons in solution in the water. This fact is occasionally forgotten, and I have known considerable carelessness shown in the choice of a water-supply, under the impression that boiling or filtration, or both combined, would effectually remove all danger. It was common enough in South Africa to find a river polluted by the bodies of dead and decomposing animals, which had found entrance to the stream at some point above the source of supply, and in such cases soluble organic poisons would certainly be present in the water. I was asked recently to account for water drawn from a shallow well being offensive to nose and palate after filtration and boiling. Inspection of the well revealed the presence of six moles and a frog, all dead and in various stages of decomposition. The inference to be drawn from the above, as regards field service, is perfectly clear—viz., that it is imperative to safeguard water-supplies, no matter what measures of purification may be in force. Even distillation may not be sufficient to get rid of poisons in solution. 'An

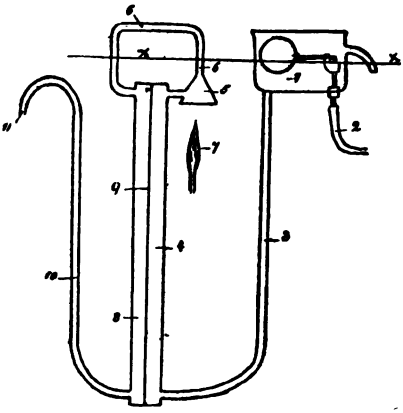

Fig. 17.—*Diagram of Waterhouse-Forbes Water Sterilizer.*

In order to easily illustrate the action of this principle, reference will be made to the purely diagrammatic drawing, Fig. 17, in which 1 shows a water-tank with a pipe 2, through which water enters, and is allowed to fill the tank up to the water level *x*, and no higher, as it is restrained by the float-operated valve shown in the tank. The water to be treated passes from the tank 1 down through the pipe 3, into the compartment 4 of the heat exchange. Rising in the compartment 4, the water enters the heater 5, and rises in the pipe 6 to the level *x*. Heat is applied to the heater 5 by means of the flame 7, which causes the water in 5 to boil over through the pipe 6 into the top of the compartment 8 of the heat exchange. When compartment 8 has become filled, the water runs off through the orifice 11 of pipe 10. While passing down through the compartment 8 the heat of the water, which is boiling hot, is transferred by conduction through the partition or diaphragm 9 to the cold water passing up through compartment 4; so that the water which is boiling in 5 passes out of the apparatus nearly as cold as that entering the apparatus, while the cold water entering the apparatus becomes heated as it passes towards the heater 5, and reaches the heater in a very hot condition, and nearly at the boiling-point. Therefore, the only heat which can be supplied is that necessary to bring the already heated water entering 5 to the boiling-point, and cause it to rise above the normal level *x* and boil over through the pipe 6, and so pass on through the remainder of the apparatus to the discharge outlet 11. It will be observed, therefore, that but little fuel is required to operate this apparatus, for the reason that the heat is conserved and used over and over again; whereas, by the ordinary process of boiling water and allowing it to cool off naturally, all the heat which is required for raising the temperature of the water to the boiling-point is thrown away. For example, if water is discharged from the Waterhouse-Forbes apparatus 5° higher in temperature than it had on entering the apparatus, but 5 units of heat are lost for every pound of water treated; whereas by the ordinary method, assuming the water to have an original temperature of 62° F., it must be raised to 212° F. to reach the boiling-point, and each pound of water treated, therefore, must have 150 units of the heat put into it, and all this is lost in cooling. It is apparent, therefore, that the Waterhouse-Forbes system is thirty times more economical in fuel.—*From Annual Report for* 1899 *of Surgeon-General of United States Army.*

outbreak of diarrhœa on board H.M. ships in the harbour of Valetta was attributed to impurities in the water distilled from the not overclean water of the Grand Harbour' ('Theory and Practice of Hygiene,' Notter, Firth, and Horrocks).

NOTE.—According to the opinions of a Board of Medical Officers of the United States Army assembled at Washington in August, 1898, for the purpose of in-

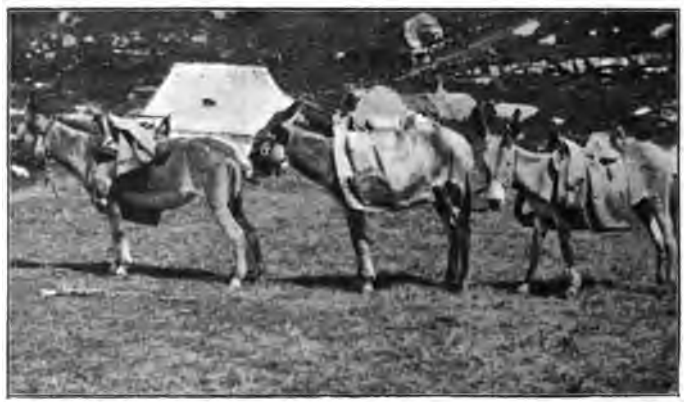

Fig. 18.—*How Water was Carried in South Africa in Localities Inaccessible to Water-Carts.*

The water-bags were made of canvas.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

vestigating and reporting on various means for sterilizing water on field service, the Berkefeld filter is not free from certain very grave objections.

In this connection the Board reports as follows: 'Further tests made by one of the members of the Board served to show that repeated sterilization by boiling brought about some change in the material of which the cylinder is made, so that bacteria were re-

peatedly found in the filtered water. In the opinion of the Board, this observation constitutes an important defect in the Berkefeld filter.' I am not aware that the above observation has been recorded in any of our laboratories. The matter is certainly worthy of careful investigation. The same Board strongly recommends the Waterhouse-Forbes water sterilizer, the principle of which is sterilization by heat. It does not, however, clarify the water ; this was not considered as a grave

Fig. 19.—*Regimental Water-Cart* (*New Pattern*).

The cart contains 108 gallons of water. An allowance of two carts per battalion appears to be adequate for ordinary circumstances.

(Photograph by Sergeant-Major A. Harwood, R.A.M.C.)

defect by the Board, as clarification can be effected by passing the water, prior to entrance into the sterilizer, through one or two water-barrels partially filled with fine and coarse sand. An account of the proceedings of the Board will be found at page 215 of the Report of the Surgeon-General of the United States Army already referred to.

Water-carts and the men's water-bottles both need

constant care. The lids of the water-carts should fit accurately, and the carts themselves kept at a reasonable distance from the precincts of the camp. As a rule, a sentry should be placed over the carts. Both water-carts and water-bottles should be frequently washed out with boiling water, with the object of destroying any living organisms of a dangerous nature which may be present.

When water in certain parts of South Africa had to be drawn from points inaccessible to water-carts, the water was carried in canvas bags on donkeys. In spite of every care, dust readily clings to the interior of these bags when damp, and the necessity for purification by filtration or other means is therefore obvious.

In connection with the subject of drinking-water in the field, recent proposals for a supply of safe water to troops on service are of great interest. As far as can be judged at present, the adoption of these proposals would appear to hold out excellent hopes, but only actual experience can show whether the measures suggested will come within the limits of practical sanitation.

Disposal of the Excreta of Patients in Field Hospitals

According to the researches of Firth and Horrocks, published in the *British Medical Journal* of September 27, 1902, the enteric bacillus can survive seventy-four days in moist soil. The above observation indicates the serious danger of disposing of unsterilized enteric excreta by means of earth burial, and the importance of this danger is still further emphasized by

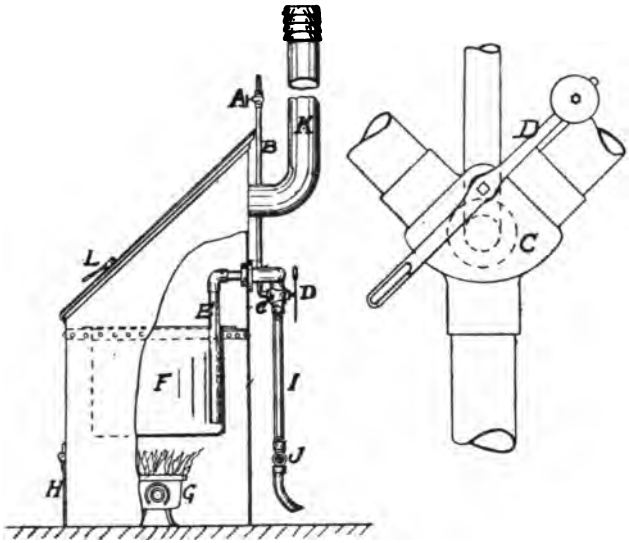

Fig. 20.—Diagram of Major Cummins's (R.A.M.C.) Sterilizer.

The upper and lower parts of the apparatus communicate by perforations in a flange connecting the vessel F with the body of the hearth, through which the products of combustion from the fire rise in a quick stream, and determine a draught which carries all vapours from F up the chimney. The utensils containing the excreta are emptied into one compartment of F, and are themselves placed in the other, each being covered with an emulsion of crude carbolic acid (about half an ounce to the gallon)—[not absolutely necessary]—which serves for the treatment of a number of charges. The contents of F are boiled, thus attaining a temperature below which the infection of typhoid fever is destroyed with certainty. (And the use of the carbolic acid serves to give a sufficient margin of safety in the event of the operation being stopped by carelessness before boiling-point is obtained, and to prevent any offensive smell from being perceived during the disinfection.) [No smell.]

When it is desired to empty the vessel, the valve CD is thrown over to close one or other of the pipes B; water is allowed to flow down the pipe B through the valve A and out through valve J; and a siphon EI is thus started, which empties the compartment of which the valve is left open.

Steam may be used for boiling where convenient, and the apparatus can be adapted for the treatment of the entire bath water of an infectious hospital.

For field purposes the vessels may be made detachable and nesting, the fire being lit in a trench in the usual way, thus providing a very portable appliance.

the fact already stated—viz., that fæcal matter percolating into the soil from latrine trenches becomes converted into basic nitrates, in which the living organism of the above disease has powers of prolonged existence. It thus becomes evident that (whether removed in latrine buckets or put into a latrine trench) the sterilization of enteric excreta is a matter of vital importance. In camps no other means of disposal are, as a rule, available except burial, as neither burning nor boiling after the manner instituted by Major Cummins, R.A.M.C., can be readily effected in a mobile unit such as a field hospital. These facts furnish one additional argument in favour of the recommendation already insisted on as to the removal of serious cases of illness from the fighting line. I have seen Major Cummins's apparatus at work, and am fully convinced of its efficiency, but the exact sphere of its utility in the field can only be determined by actual experience. Burning is, of course, a perfect safeguard as regards the destruction of the bacillus, but, in the absence of special apparatus, it is apt to be carried out in a perfunctory manner; and where this is the case, the unburned residue is a serious source of danger.

When in charge of a field hospital, I directed that all vessels for the reception of solid and liquid excreta should contain a 10 per cent. solution of carbolic acid. This measure may have been efficacious in destroying the enteric bacillus as far as the urine of patients was concerned, but whether the germicidal fluid ever came into sufficiently intimate contact with the solid excreta to effect the same result is a matter concerning which I have considerable doubt. The measure was not limited to patients suffering from enteric fever, but to all except

those who had been admitted with minor injuries or other disabilities of an unimportant nature. This may have seemed rather an unnecessary proceeding, but I found that a general and comprehensive rule was far more likely to have good results than one which minutely differentiated those cases in which the measure was necessary from those in which it was not.

In any event, the use of a germicide and deodorant in urinals and close-stools is only a measure of cleanliness and common-sense sanitation. There was apt to be considerable difficulty in enforcing the above measure in the case of patients who felt capable of using the latrines, and at times this practice had to be rigorously dealt with. Sick men, if not watched, would occasionally pass water just outside the hospital tent, and, in view of the prevalence of enteric fever in the field hospitals, the resulting danger of the above act was of a most grave nature. To pass water anywhere but in a latrine trench or bucket should be made a serious military offence in all camps.

I think that there can be little doubt as to the dissemination of enteric by mild cases of the disease diagnosed as simple continued fever. As such patients often pass water anywhere, the danger of the spread of infection by means of urine is most serious, and is even more to be dreaded than the influence of the fæces in the same direction. The physical characters of the fæcal excreta call for the immediate removal of the latter; but as regards urinary excreta matters are altogether different, and men can pass water which, without leaving any manifest trace, is nevertheless possessed of deadly potentialities.

Disinfection of Tents

In field hospitals it should be made a practice as far as possible to disinfect tents which have been occupied by men suffering from any form of disease likely to spread. Scrubbing the interior of the canvas with strong solution of carbolic acid should prove a fairly efficacious measure. Unfortunately, with mobile units a systematic recourse to its procedure cannot possibly be insured. In dealing with marquees where the whole of the tent cannot be readily reached, the alformant lamp would prove an excellent means of disinfection. It is portable, easily worked, and, in the hands of a trustworthy and intelligent person, its use is not attended by danger of any kind. The 'Hydroformant' is stated to be superior to the 'Alformant' lamp, but I have no personal experience which enables me to express an opinion on this matter of relative value.

Disinfection of Clothing

The readiest way to carry out this step, in the absence of special apparatus, is to dip the articles in boiling water, being careful to first remove with warm water and soap all stains of blood or fæces, which would, as is well known, be fixed by boiling. A Soyer's stove answers the purpose of a disinfector, and, although the above procedure is a most tiresome one without the proper means for the purpose, it can nevertheless be carried out, and carried out effectually. As I was anxious to see what periods of immersion were necessary in the case of different articles, I made some experiments to determine this point. The method of in-

vestigation was simple in the extreme. Slips taken respectively from the regulation shirt, great-coat, khaki drill-jacket, and blanket were soaked in sewage effluent taken a few hours previously from the fields of a sewage-farm. The slips were next dipped for varying periods in boiling water, and then sewn—separately, of course —into tubes containing different nutrient media. The media used were bile salt broth (McConkey and Hill), nutrient gelatin, milk, and beef broth.

Without going into further details, the general result that I arrived at was that five seconds' immersion was quite sufficient for the purpose indicated as regards khaki drill and shirts, but that the blanket or great-coat should be immersed for ten seconds. The object of the process being to destroy all developed forms of life, there is no doubt that it answered its purpose. Spores, as might have been expected, survived. No damage was caused by the process. It is important to note that the supply of water should be plentiful, otherwise the introduction of a bulky article reduces the temperature below boiling-point. Blankets and great-coats should be lowered gradually into the water, and the parts disinfected should be withdrawn after the required period of immersion, and other parts substituted. The time required appears to depend a good deal on how the articles are immersed, as regards both blanket and great-coat. If they are placed in the water folded up, a period of sixty seconds may be necessary for the purpose in question, but if care is taken, as indicated above, ten seconds seems to be ample. I think that, as care cannot always be insured, thirty seconds' immersion should be allowed in the field for the articles last named. As a matter of fact, the periods which I

employed in South Africa were considerably longer than those given above, but I certainly never knew any of the articles I have named to sustain any appreciable damage. As they have not been confirmed by others, I should be sorry to make any dogmatic assertion as to the value of the above results, all that I would claim for my experiments being that they appear to indicate a ready method of carrying out a procedure which may at any time be required on field service.

Disinfectants in the Field

The so-called disinfectants in common use in the field cannot in most cases have anything more than a deodorizing action. Many of the widely-sold 'carbolic powders' contain practically no available carbolic acid, and the action of chloride of lime, a popular field disinfectant, depends upon the presence of an acid which may or may not be present; the chemical action which should take place before the necessary chlorine can be evolved is represented by the following equation:

$$CaCl,Ca(ClO)_2+2H_2SO_4=2CaSO_4+2HCl+2HClO;$$
$$2HCl+2HClO=2Cl_2+2H_2O.$$

When used in camp, the necessary acid may be non-existent, and in this case the evolution of chlorine remains in abeyance. There is no doubt that the usual camp disinfectants are of considerable utility, but not in the sense that their name implies. Their use, among other things, is an object-lesson in the necessity for removing or covering organic refuse, and they most probably prevent to some extent the spread of infection from the latrines by means of flies, besides acting as

excellent deodorants; and for these reasons the substances in question should not be discarded.

It seems, however, absurd to imagine that chloride of lime sprinkled about the surroundings of the tents is likely to have any other effect than that of masking odours more disagreeable than its own. The observation of Dr. Louis Parkes as regards this particular disinfectant is well worth remembering. It is as follows: 'It tends to dissolve the albumin of fæcal and other matter; its power, however, may be entirely exhausted upon such organic matter, and bacteria may in consequence escape.'

It is also plain that, no matter how efficacious these substances may be, it is perfectly impossible on service to bring them into sufficiently intimate contact with the substances which they are intended to disinfect to actually attain the object for which they are intended.

For purposes of general applicability in the field, liquid carbolic acid is one of the best genuine disinfectants we possess, and the same may be said of izal. The utility of boiling water in this connection has already received attention.

Food and Alcohol

The question of food would be most likely to concern those officers stationed at the base, who are responsible for the supplies sent into the field to the various fighting units. The question of biscuit is, however, one which directly concerns the medical officer in charge of troops in the field. Men in South Africa constantly complained of the effect of the prolonged use of biscuit on

the teeth, and with defective teeth the soldier on service has before him a long and dismal vista of gastro-intestinal troubles. Field ovens are readily made, and where it is practicable flour should be issued as a ration. The above measures were carried out with excellent results along the Harrismith and Bethlehem and Harrismith and Olivier's Pass blockhouse lines in the winter and early spring of 1902. Yeast cake was originally issued for baking purposes, but it was not satisfactory. It rapidly deteriorates, and even when it is in good condition it requires a very fair amount of skill if it is to be successfully manipulated. When this skill is procurable, and other conditions are favourable, yeast cake or yeast should be preferred to baking-powders; but where the necessary skill is absent, bread made as above is apt to contain either excessive fermentation products or, on the other hand, to be insufficiently fermented. For this reason baking-powders, provided that they are free from alum, are generally to be preferred for use in the field. Baking-powders were accordingly issued to the blockhouses, and the bread that was turned out was of irreproachable quality.

The plan of putting up food in small tins is one, on the whole, to be recommended, as it limits the chances of ptomaine poisoning. The method of examining tins containing preserved food, as stated in 'The Theory and Practice of Hygiene,' by Notter, Firth, and Horrocks, is very practical, and worth committing to memory.

According to these directions, tins should be rejected when (1) perforated by nails; (2) when there are any angular indentations which are likely to have caused

partial fracture of the tin, and render it liable to rust; (3) when they contain deleterious gases, or are bulged or blown; (4) when they are rusty; (5) when it is found that the tin has not been hermetically soldered, so that the meat has either dried or putrified in consequence. After being examined in relation to these points, the tins should be struck lightly with a small wooden mallet, and those producing a hollow sound, suggesting incipient putrefaction, or that the tins have not been filled to the full capacity, should be rejected. Tins might be passed in good condition by an officer at the base, and have deteriorated in transit to, or after arrival in, the field. They should therefore be examined before use, the examination being carried ou on the lines indicated above.

Every effort should be made as far as possible to vary the rations in the field. Monotony of diet produces a dangerous condition of gastric disorder, mainly manifested by an absolute loathing of food. The condition in itself would probably not be a matter of very serious import, but that it appears to render those who suffer from it particularly susceptible to certain forms of disease, notably enteric fever. I am not prepared to make an absolute assertion as to the above fact, but I have noticed the relationship in question sufficiently often to justify the assumption that it is in all probability something more than a merely fortuitous occurrence. There is no doubt whatever that men suffering from gastric troubles are peculiarly liable to dysentery.

Soldiers should be carefully warned against partaking of the natural products of a country until their properties have been thoroughly ascertained. An

illustration of danger in this connection has already been given.

The field rations of the force in Natal, and, in fact, everywhere, as far as my own experience went, were, owing to the admirable arrangements of the supply department, of excellent quality, and it would be diffi-

Fig. 21.—*Drift near Harrismith.*

The photograph illustrates the difficulties encountered by the transport in furnishing fresh meat to the troops when the rivers were in flood. Sheep are seen in water at the far side of drift.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

cult to say how the former could possibly have been improved on. One great point was that variety constituted a leading feature, and although monotony was at times absolutely unavoidable, it did not, as far as my own experience justifies me in forming an opinion,

result in the suffering which I have observed elsewhere from a similar cause. Apart from official sources of supply, a great deal may be done by individual commanding officers in availing themselves of the natural products of a country. On the Olivier's Hoek blockhouse line the men had fresh milk, poultry, and eggs,

Fig. 22.—Blockhouse of the Manchester Regiment, with Goats for Milking.

The photograph illustrates what can be done by commanding officers in providing live stock for the use of the men. The blockhouses on the Harrismith-Olivier's Pass line were well furnished in this respect, with the best results as regards health.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

and excellent fruit was obtained from the orchards of deserted farms in the district.

There is, however, one question which must be particularly referred to here. It is, How far is a spirit ration advisable in the field ? Speaking from my own

experience, I have rarely seen good come of such a ration, and very frequently much harm. To attempt any detailed discussion of this point would, without doubt, lead too far from the present subject. Suffice to say that alcohol, in the form of spirit, is, without doubt, most useful as a valuable adjunct to digestion and assimilation after great exertion and when the body is thoroughly fatigued. Under such circumstances the use of a moderate quantity of spirit is strongly to be recommended. It should be freely diluted, and under no circumstances should it be swallowed neat.

It is a dangerous but extremely common error to imagine that spirits are a safeguard against cold. As a matter of fact, nothing could possibly be worse, and it is a matter of regret that the effect of alcohol on the loss of body heat is not more generally known, and not only known, but acted on. Speaking from personal conviction, I believe that alcohol in the field should only be issued to the men after they have been exposed to exceptional strain in the way of physical exertion, and that the practice of serving out 'tots' of rum on a cold night should be absolutely discouraged. More serious still is the practice of bringing beer into the field for the use of the men. Its presence is directly conducive to crime and to irregularities of all sorts. It is not only unnecessary, but distinctly harmful to men whose duties subject them to severe mental and physical strain. I should here make it clear that I have not the slightest intention of acting as a partisan on behalf of the temperance question. Whether alcohol is desirable as a beverage in peace time is altogether outside the present subject, which is con-

cerned only with the question of alcohol during service in the field.

During periods of enforced abstinence troops improve both physically and morally. The suffering caused by a craving for alcohol among those habituated to its use is fortunately not of a lasting nature, and is attended by no bad results; and military achievements of which, as a nation, we have, without undue boastfulness, good reason to be proud, have been carried out by troops who have not tasted alcohol for months.

The sanitary recommendation which follows as the natural consequence of the above is the absolute prohibition of alcohol, except under circumstances already indicated. The days are long since past when it was considered necessary to fire men to combat and victory by means of extra potations on the eve of battle, and such means are fortunately unnecessary to call forth the courage of the British soldier.

MARCHES

The general principles which guide medical officers in charge of troops on the march are well understood, and have been fully discussed by standard writers. There are, however, some points in this connection which may be briefly considered here without risk of uncalled-for repetition.

The recent regulations with regard to the abolition of the valise, and consequently as to weights to be carried on the march, can have nothing but the most beneficial results, not only as affecting the comfort, but also the efficiency, of the soldier.

The total weight carried by the British infantry soldier in marching order, inclusive of all articles of clothing, is approximately 45 pounds. The absence of the valise and its contents has diminished the load by

Fig. 23.—*Private, 2nd East Yorkshire Regiment*
Showing front view of equipment carried on the march.
(Photograph by Sergeant-Major A. Harwood, R.A.M.C.)

10 pounds. Articles which were formerly carried on the person are now carried in the waggons.

In foreign armies the men are still laden, like beasts of burden, with a mass of material which should find its

proper place in the regimental transport. In addition, however, to lightening the load to be carried, there are a variety of other means by which the soldier on the march may have the severity of his task diminished,

Fig. 24.—*Private, 2nd East Yorkshire Regiment.*
Showing back view of equipment carried on the march.
(Photograph by Sergeant-Major A. Harwood, R.A.M.C.)

and his effectiveness proportionately increased. One of the most obvious of these is the avoidance, as far as possible, of marching in close formation, as under such circumstances the accumulated respiratory

products must have a deleterious effect upon the vital powers of the men.

Dust, besides being a possible vehicle for the dissemination of disease, is a constant source of annoyance to marching troops, and for this reason infantry, as a rule, should not march in the immediate proximity of cavalry, artillery, or transport.

Prolonged halts are not advisable. The muscles have time to stiffen under such circumstances, and the march is usually resumed with a sense of languor and fatigue. The principle of short and frequent halts was carried out in Lord Roberts's historic march to Kandahar. The same measure is recommended by Munson: 'In the prevention of exhaustion on the march from too continuous effort, the column should be halted at suitable intervals for periods of rest, and for this purpose frequent short halts during the march give more satisfactory results than by marching with fewer and longer delays *en route*' ('The Theory and Practice of Military Hygiene,' Captain E. L. Munson, United States Army).

The above, taken in the light of advice, can scarcely be improved on. During long halts men are apt to get thoroughly chilled—a fact which is directly conducive to sickness and consequent inefficiency. The above objections to prolonged halts—viz., stiffening of the muscles and danger from chill—do not apply when the march is resumed after a short rest of about half an hour or less. Irregular halts of uncertain duration are a source of annoyance and fatigue, and, as the larger the force the more likely such halts are to occur, it becomes a matter of consequence to move troops, as far as possible, in small and separate bodies. Apart alto-

gether from the frequent obstacles which arise when heavy transport, guns, cavalry, and infantry occupy the same road, the physical powers of the men appear to be diminished when the latter are aggregated together

Fig. 25.—*Sergeant-Major, 2nd East Yorkshire Regiment.*
Showing equipment carried by warrant officers on the march.
(Photograph by Sergeant-Major A. Harwood, R.A.M.C.)

in excessive numbers. This is probably due to the same cause as that referred to regarding marching in close formation—viz., excess of respiratory products. The exhalations of many men, although in

the open, must infallibly tend to approximate surrounding conditions to those peculiar to defective ventilation, such as is met with in barracks or elsewhere.

Soldiers, if allowed to do so, will drink constantly on the march, and, if unrestrained, would readily empty the regimental water-carts at times when economy of water may be a matter of the highest consequence. Water-bottles should, of course, be filled before starting. Cold tea is an excellent beverage, and is often preferred by the men, as being more refreshing than water.

Cleanliness is a matter of the greatest importance, chafing of the skin being often the direct result of the friction caused by the clothing on limbs from which decomposing, and consequently irritating, perspiration has not been removed.

If no other part of the person can be cleansed, the feet should certainly not be neglected in this respect. The socks also should be washed on every possible occasion, but it is most essential that they should be thoroughly dried. Damp feet and damp socks readily cause abrasions of the epidermis. It cannot be too strongly insisted on that the feet should be kept as dry as possible during a march. Men are very careless in this respect, and will often put on socks, after washing, when the feet are still wet. Particular care should be paid, when drying the feet, to the spaces between the toes. Cracks are very apt to occur in these parts if moist, and the result is both painful and disabling. The use of hot water in washing the feet after a march, although comforting, is not to be recommended. The heat tends to soften the epidermis, and therefore to encourage the production of blisters and abrasions. The socks should always be changed, when possible, at

the conclusion of a march. It is a good plan for men to wash their socks as soon as possible after arrival in camp, the same socks being carried next day, and substituted at the evening halt for those that have been worn since the previous night.

An enormous number of methods have been suggested for preventing sore feet. Very finely-powdered chalk placed in the boots seems to give good results. Flour or oxide of zinc may be used in a similar way, or a mixture of alum and salicylic acid. Greasing or soaping the socks are methods well known to soldiers. Some of the above means are not likely to be generally obtainable on active service, and the soldier in the field will have to adapt the method which he employs to the surroundings in which he happens to be placed.

Food should be sparingly partaken of during the march, the principal meal of the day being eaten after arrival in camp, when, under conditions already stated (see section on Food and Alcohol), a certain quantity of alcohol may be taken with considerable advantage.

Medical Inspections

These should be, within reasonable limits, as frequent and as thorough as possible. Particular attention should be paid to the men's eyes. All cases of the nature of contagious ophthalmia should be isolated at once. This disease could scarcely fail to spread rapidly in a camp.

The principles of food-supply are well known, and need not be recapitulated here ; but the medical officer should take pains to ascertain if any particular article of diet is causing disgust amongst the men, and for this

purpose inspections should frequently be made at the dinner-hour. The medical officer is then more likely to obtain satisfactory information as to the results of cooking and of the men's well-being in this particular direction. Cleanliness, condition of men's feet, etc., will, of course, receive attention as matters of ordinary routine.

Digestive troubles should always be detected if possible, as they are often in the field the direct predisposing causes of serious troubles. It is difficult to insist too strongly on the extreme importance of this point. Careful note should also be taken of the number of men in each tent, overcrowding being a fruitful source of disease, and in camps it is apt occasionally to be overlooked. As far as is possible the numbers should be widely distributed. In making a medical inspection, it is a good plan to have the men drawn up by half companies, and, after walking down the ranks, to ask, 'Any complaints?' If a few men only are inspected at a time there is a far better chance that physical disabilities will be detected, besides which a small number will be far more likely to bring just complaints to notice than when large bodies are paraded together.

The non-commissioned officers, in particular, should be questioned as to the general well-being of the men. Private soldiers are often unreasonably suspicious, and have an altogether unfounded dread of committing themselves by answering questions which are framed entirely with a view to their own welfare. For this reason it is of high importance that the medical officer should endeavour to gain the confidence of the men. The regimental system no doubt fostered a feeling of confidence, but even under altered conditions of service

a medical officer who succeeds in carrying conviction as to the good faith of his motives will find the soldier both grateful and appreciative, and the good understanding that results on both sides should certainly bear satisfactory results.

I trust that the above will not be construed as an attempt to instruct medical officers as to their dealings with the men. The remarks in question are only intended as an expression of my own views ; the opinions of others may be entirely different.

Clothing

The principles which should serve as guides in the selection of suitable clothing for the field are sufficiently well known, and there is therefore little that need be stated here as regards this aspect of the subject. The service garments of the British soldier are well adapted for the purpose for which they are intended, and the following remarks apply to articles which only come under the category of clothing by a somewhat elastic use of the term in question.

It is doubtful whether the advantages of the cholera-belt are thoroughly appreciated. Young soldiers, especially those who have lately arrived from home, often regard such articles with contempt, and it would therefore appear desirable to make its use as obligatory as that of the ordinary forms of clothing, and to regard a neglect to wear it in the light of a military crime. It appears, on the face of it, to be absolutely illogical to condone the offence of neglecting means provided by the State for the maintenance of physical efficiency.

Boots are often a source of trouble. The newest form of boot has the sole fastened to the upper by means of screws, the boots being made by machinery. Army shoe-makers state that the machine by which the screws are inserted works with such force that the soles are compressed into the consistence of a board, and the result is that movement at the transverse tarsal articulation is impeded, and the foot has more or less to be lifted as a whole.

Men state that they much prefer the old 'clumper' boot for comfort. It certainly presented the advantage of being comparatively simple in construction, so that on service it was possible for a man to put on a new clump himself. Rivets only were used for this purpose, but it would be impossible for the unskilled to manipulate the screws in the soles of the present boots. The screw machine-made boot is cheaper than the 'clumper' boot, but whether cheapness is obtained at the expense of efficiency in marching is another matter. Men state that the former boot causes considerable pain across the arch of the foot after some hours' use, besides which blisters appear to be readily induced; and if this is the case, the subject would not appear unworthy of extended investigation. A more precise recommendation in the absence of exact knowledge cannot be framed.

The pattern of boot issued to men while on foreign service is one of the best possible. It is strong, pliable, and generally satisfactory.

Although the subject calls for nothing in the way of a sanitary recommendation, the consideration, as affecting the general efficiency of the soldier, of certain articles which have of late been added to the men's

equipment can scarcely fail to be of interest. Among these additions, the issue of woollen drawers to the infantry recruits on enlistment occupies a prominent place. Trousers on service become horribly foul without drawers, and are a common cause of chafing of the skin and actual ulceration during marches. Woollen drawers are an excellent protection both against such occurrences and also against chill to the lower extremities when the trousers are wet from rain, or, as is often the case, from perspiration. The introduction of the slouch hat is also an excellent measure. This form of head-dress, although doubtless not adapted to all climates, could not well be bettered for comfort or general utility, and is an enormous improvement on the old field-service cap as regards protection against sun. The issue of the cardigan waistcoat is an innovation likely to be followed by the best results. To a certain extent, this garment supplants the great-coat as a protection against cold, the weight of the latter being a great objection to its use. When wet with rain, the weight is, of course, very materially increased.* The 'silver-gray' flannel shirt is far superior to the old pattern shirt, as the latter had too much cotton in its composition to fulfil an ideal either of health or comfort. Cotton, as is well known, is a most indifferent protection against cold, unless the fabric is very loosely woven, in which case the resulting spaces, in virtue of the air which they contain, have, to a certain extent, a

* Whether waterproof clothing will ever be brought into general use in the army is at present a matter of uncertainty. What appears to be a rapid and efficacious method of rendering uniforms impervious to wet, by means of wool-fat, has been described by Captain Munson, United States Army. The means in question would certainly seem worthy of an exhaustive trial.

non-conducting influence on heat. The rapid evaporation of moisture from cotton is also a danger to the wearer, in consequence of the chilling effect produced. The principles of which the above improvements are the practical expression are by no means limited to our own army, but admit of equal applicability as regards the soldiers of all civilized Powers.

Prevention of Malaria

Unfortunately, I have no personal experience of the prevention of malaria on active service, such practical knowledge as I possess in this connection being gained in peace-time only. It is, however, quite permissible, and even necessary, to regard the lessons learned in peace as applicable, in a general way, to the altered conditions attendant on war.

In the spring of 1898 the sick and wounded of the 3rd West Indian Regiment, which had been engaged in a punitive expedition in the West African hinterland, arrived in St. Helena.

By far the greater number of these men, about seventy in all, were suffering from malaria in different forms, and although, with one exception, they all made good recoveries, it became a serious question as to how recurrences of this disease could best be prevented.

It is quite true that the men were removed absolutely from malarial influences; and prophylaxis in a non-malarial country consists, not in guarding the patient against further entrance of the poison, but in eliminating the poison so far from the tissues as to prevent its being kindled into activity by external causes distinct from the disease itself. This I found

could only be effected by the prolonged administration of quinine, coupled with such common-sense measures as avoidance of cold, fatigue, etc., and attention to the general health. The results were excellent, and my experience led me to believe that, while removal from exposure to the disease is of the first importance, this measure must be supplemented by treatment such as that mentioned above. I certainly believe the prolonged administration of quinine in small quantities to be of the highest value, as it was made perfectly clear to me that this drug was essential to ward off recurrences, which latter occurred on the very least provocation. No particular rule as to dosage was adopted. Each case was judged on its own merits, and in a few months' time malaria amongst the men of the unit in question had practically disappeared.

Although averse to the use of alcohol in the field, I believe it would be of great value in aborting attacks of the disease. At St. Helena my routine treatment at the beginning of a seizure was the administration of 5 grains, or often 10 grains of quinine, with hot brandy and water. I think the alcohol in this case stimulates the vital powers of resistance to increased activity. At any rate, whatever the exact explanation may be, I had every reason to be satisfied with this plan of treatment. I found the cold stage to be materially shortened, an effect which was encouraged by the administration of beef tea or Liebig's extract, taken as hot as possible.

It would be presumptuous on my part to compare this very limited experience with that of officers who have been in contact with the disease for years, and who have studied it under a variety of forms. I there-

fore do not wish to regard my own statements in any other light than as a very limited contribution to a subject of vast extent and corresponding complexity.

There is one point, however, in connection with malaria on which I can speak with some certainty, and that is the resemblance which it bears to accepted descriptions of yellow fever. I fail to see how certain cases which are comparatively common in certain of the West Indian Islands, and which I remember were styled 'bilious remittent,' could clinically be distinguished from the more serious disease referred to above; and what I would therefore urge is a routine examination of the blood in all febrile cases occurring in a malarial country, or in one where yellow fever is capable of existence. The procedure is one of no difficulty, and the value of the results need scarcely be insisted on. This measure may be out of the question with mobile bodies of troops, but it certainly should be carried out at all stationary medical establishments. Whether there is any pathological connection between malaria and yellow fever is a question which cannot at present be answered, but it appears certain, according to recent brilliant investigations carried out by the Americans in Cuba and Havana, that the essential cause of this disease is transmitted from the sick to the healthy by means of one species of mosquito, which is the *Stegomyia fasciata*. The actual germ of the disease has, as far as I am aware, not yet been isolated. Reviewing the above facts, the following recommendations appear to be called for as regards the prophylaxis of malaria in the field:

1. The avoidance, as far as possible, during opera-

tions in malarial countries, of camping troops in the neighbourhood of water, more particularly slow-running streams or stagnant pools.

2. The avoidance of localities where the genus Anopheles is noticed to be in existence. Evidence in this connection may be obtained from persons possessed of local knowledge.

3. The filling-in of all stagnant collections of water, or, if this is not possible, the covering of the surface of the water with petroleum. I have no actual experience of the last-named measure, but, judging from the statements of others well qualified to speak, it must be of considerable value.

4. The administration of small doses of quinine.

For diagnostic purposes, as already stated, the use of the microscope should never, when possible, be omitted.

The distance to which the disease may be carried is a most important point, and should be constantly borne in mind in selecting either a camping-ground or a place of anchorage for a ship.

Prevention of Parasitic Diseases in the Field

Although the subject of parasitic diseases in general presents no peculiarities as regarding active service, it may not be out of place to point out certain particular facts as regards prophylaxis in this connection, which facts, although doubtless well known, might possibly escape attention in the multiplicity of details necessary to maintain physical efficiency in the field.

Speaking generally, the prophylaxis of internal parasites consists in the purification of drinking-water

by boiling or filtration, the sufficient cooking of meat, and the avoidance of raw vegetables as articles of diet.

The ova and the embryos of the following parasites have been found in water, and may be taken into the stomach of man when such water is used for drinking purposes :

Tænia solium, *Ascaris lumbricoides*, *Oxyuris vermicularis*, *Bothriocephalus latus*, *Tænia echinococcus*, *Rhabdonema intestinale*, *Filaria sanguinis hominis*, *Anchylostoma duodenale*, and *Filaria dracunculus*.

The above is a sufficiently long, if not absolutely comprehensive list, but, with the important addition found immediately below, it comprises all those forms with which the medical officer is likely to be called upon to deal.

Certain of the above are also, as is well known, commonly present in meat, but perhaps the most important parasite in this connection is the *Trichina spiralis*, which, being encased in a calcareous cyst, requires a temperature of 150° F. for its destruction ; and as this degree of heat is not always attained in military cooking in the field, pork, in which the parasite is commonly found, should not be used as an article of diet by troops on service. As already stated, pure water and satisfactory cooking are, as a rule, efficient preventatives of the attacks of the parasites in question. There are, however, other points in this particular connection which should not be disregarded. It is, for instance, an admitted fact that the ova of the *Anchylostoma duodenale*, after being voided by man, develop in damp earth. It is also well known that this parasite is particularly apt to attack persons whose calling renders

them liable to constant contact with the soil, and it is now a matter of history that a most serious form of anæmia, which for a time crippled the operatives engaged in boring the Mont Cenis tunnel was directly induced by the means above referred to. Considering the circumstances under which both officers and men are constantly called upon to consume their food while in the field, the danger to which they may be exposed in this connection is sufficiently obvious. Although it may be too much to expect that, even when within bounds of easy attainment, acts of reasonable cleanliness will be in all cases carried out by soldiers on service, it may nevertheless serve a useful purpose to warn the men as to the risks which they incur by consuming their food with unwashed hands. It need hardly be added that the danger of such an act is by no means limited to the chance of invasion by the organism under consideration.

In view of the wide distribution of the ankylostoma, the danger which has been indicated immediately above is by no means so unlikely as might be imagined. The parasite has been detected, not only in the West Indies, Egypt, Zanzibar, Gold Coast, South America, and Bengal, but it is also commonly found in different parts of Europe.

Somewhat akin to, and commonly associated with, the above is the *Rhabdonema intestinale*. It has been found in Germany, Ceylon, Italy, Brazil, Egypt, and the West Indies. It was discovered by Normand in excrements passed by French soldiers suffering from the so-called Cochin-China diarrhœa ('Theory and Practice of Hygiene,' Notter, Firth, and Horrocks).

The embryos, which thrive in earth or foul water, are

hatched from the eggs before the latter are expelled from the intestine. This is a practical point of difference between the *Rhabdonema intestinale* and the *Ankylostoma duodenale*. In the former the embryos, being passed with the fæces of the host, are likely to perish if exposed to unfavourable conditions; in the latter the embryos are only hatched after leaving the body, and, although their life-history has not yet been definitely worked out in all its details, there is reason to believe that the ova have every chance of survival in damp soil, the probability of their development being increased by high temperature and exposure to air—conditions, on the whole, which are fairly readily obtainable.

The means by which these parasites effect an entrance to the human body appear to be the same in both cases—viz., transference from soil or dirty water, most probably by the conveyance of food to the mouth by unwashed hands.

Bilharzia hæmatobia was frequently observed in South Africa. The principal and often the only symptom by which its presence may be known is hæmaturia.

According to the researches of Sonsino, it appears that the larva gains access to the human stomach by being swallowed inside the body of some small fresh-water crustacean, and the usual means, therefore, adopted for water purification should do all that is required in the way of prevention, as far as drinking is concerned. It is, however, well known that the ova are voided with the urine and fæces, and that if transferred to water the continuance of their existence is in all probability insured. It would therefore appear ad-

visable to sterilize, when possible, the excreta of patients suffering from this disease.

Cutaneous parasitic diseases scarcely call for any special remark. They would, of course, be detected at the regular medical inspections, and dealt with on usual lines of treatment. The main difficulty in these cases would consist in the disinfection of vermin-infested clothes and blankets.

Personally, I can think of nothing better than the use of boiling water in the manner already indicated. Ova may remain absolutely unaffected by antiseptic solutions at ordinary temperatures, besides which some of these solutions are dangerous, or else are not readily obtainable—difficulties which do not present themselves in connection with the former method suggested.

Apart altogether from the manifest danger accruing from snakes and scorpions, the practice of walking about in camp with bare feet, or of sleeping on the ground, may prove fruitful in tropical and subtropical countries in inducing attacks on the part of a variety of parasites, notably the jigger or chigre. To avoid sleeping on the ground during operations in the field is often a matter of impossibility, but it nevertheless constantly happens that the soldier, when he has a choice as to a resting-place, will select for this purpose the most undesirable spot possible. I have often seen men go to sleep under trek-waggons, instead of on them, and by so doing exposing themselves altogether unnecessarily to serious danger. Hammocks are inexpensive, readily made, and easy of carriage, and, although in many campaigns they would be absolutely useless, their presence under certain conditions of warfare

would be of extreme value both as regards comfort and safety.

In view of the above, the general measures which suggest themselves in this connection are as follows :

1. Sufficient cooking of meat and vegetables.
2. Purification of drinking-water by boiling or filtration.
3. Cleansing of the hands before partaking of food.
4. Avoidance of sleeping on the ground, or of unnecessarily walking about with the feet bare.

CHAPTER V

THE SANITARY ORGANIZATION OF A FIELD FORCE

It is, of course, well known that the extended field of medical science is a bar to obtaining what may be called comprehensive efficiency, and it follows that men have devoted themselves to those branches of professional knowledge for which they felt special inclination, or which they believed to lie particularly within the compass of their attainments.

The subdivision of labour is a well-known principle, not only in a calling dignified with the name of profession, but in the various trades, manufactures, and commercial undertakings on which the well-being of civilized communities must depend. That the recognition of this principle in the medical service of the army is essentially salutary can scarcely be doubted, and should be followed by the best results as regards the State and also the individual. The knowledge required for any reasonable degree of efficiency in sanitation has little in common with that necessary for the practice of other departments of medicine, and for this reason the term 'specialism' as regards this particular subject appears to be peculiarly applicable.

If the principle of the subdivision of labour is a sound

one, it follows that a multiplicity of functions vested in one individual does not, as a rule, lead to the best results. It seems, for instance, scarcely reasonable to expect an administrative medical officer of high rank to occupy himself with the highly technical and scientific details of sanitation, which have no immediate connection with the extremely responsible and onerous duties which he is already called upon to perform. The appointment, in fact, of sanitary officers in the field to act under principal medical officers would appear to be a necessity.

It is not meant to infer by the above that the existence of a sanitary specialist should relieve the administrative head of all responsibility as regards sanitation. The principle that the official superior is responsible for the acts of his subordinates need not be departed from.

It is comparatively simple to approve of sanitary measures when all necessary data have been collected, both as regards the necessity for and the means of carrying out such measures.

To give reasonable effect to the relative responsibilities of a principal medical officer and a sanitary officer in the field it is necessary that the latter should occupy what may be called a central position. He should be in constant relationship with his principal medical officer, in order that the official superior may be fully advised as to the sanitary condition of the force, and as to all measures which the sanitary officer may deem essential. His main qualifications should be a competent knowledge of the principles of modern sanitation, and the common-sense and experience necessary to apply these principles to the conditions of field service.

The presence of a sanitary officer on each divisional staff in the field would be a most desirable measure, as he would be kept in constant touch with the principal medical officer and chief staff officer ; and this circumstance, by facilitating the substitution of personal discussion for correspondence, would obviate the friction, delay, and misunderstanding with which official letter-writing is at times not wholly unconnected.

The duties of the sanitary officer of a division would, in general terms, be those detailed in paragraphs 663-673 ' Regulations for Army Medical Service,' 1900, as affecting the principal medical officer of a division.

It is perfectly evident that these duties are of such an extensive nature that they could not by any possibility be adequately carried out by a single individual, and that assistance, therefore, would without doubt be required. This assistance could readily be obtained from the medical officers in charge of the units. Of course, the contents of the above paragraphs does not absolve the last-named officers from the performance of sanitary duties, and it should be incumbent on them to supply the sanitary officer of their respective divisions with written information which would guide his attention to matters where his services would be particularly required. Having regard to the extensive nature of the duties compr sed in the sanitary care of a division, it is possible that, in default of such information as that just referred to, most valuable time might be wasted in dwelling on matters of minor importance, to the detriment of those of a vital nature. In the field it is a matter of particular importance to avoid, as far as possible, a multiplicity of official documents of any kind, and written statements, in this connection, should

be as brief and as concise as possible, provided that nothing essential is omitted. What is and what is not essential must be left to the judgment of individuals, and for the accuracy of their judgment they must be held responsible.

What would appear to be required is a short weekly manuscript report stating briefly in the form of a table the incidence of certain diseases on whatever unit the report refers to. The form of table is indicated below. The diseases which should be included might be made the subject of a special order. The list need only comprise those morbid conditions which occur in an epidemic form, or which are the result of insanitary conditions.

The designation of the hospital to which the cases are sent for treatment should invariably be included.

SUGGESTED FORM OF REPORT TO BE RENDERED WEEKLY BY MEDICAL OFFICERS IN CHARGE OF UNITS.

1ST YORK AND LANCASTER REGIMENT; APRIL 28 TO MAY 4, 1901.

Companies.	Diseases.				Total.
	S. C. Fever.	Enteric Fever.	Diarrhœa.	Dysentery.	
A	5	—	4	1	10
B	6	1	5	2	14
C	1	—	1	—	2
D	—	—	2	—	2
E	—	—	3	1	4
F	—	—	2	—	2
G	—	—	1	1	2
H	—	—	1	—	1
Total	12	1	19	5	37

The cases marked 'S. C. Fever' all exhibited a high temperature, without any ascertainable physical signs of diagnostic importance.

The cases marked 'Diarrhœa' are apparently of a mild nature. Two of these cases have shown a slight rise of temperature. Both the cases in question are in A Company.

The cases marked 'Dysentery' in B Company promise to be exceptionally severe; the remainder do not call for comment. All cases sent for treatment to No. 16, Stationary Hospital, Spitz Kop. Since the 27th ultimo, the date of my last report, filtration of drinking-water in A and B companies has been to some extent omitted owing to the non-arrival of candles for the Berkefeld filters. The requisition for the candles was originally forwarded on the 25th ultimo. An urgent requisition has since been sent in.

Conditions referred to in last week's report are unaltered. Rain has fallen heavily during the past week.

Captain R.A.M.C., Medical Officer in Charge 1st York and Lancaster Regiment.

ELAND'S RIVER DRIFT,
May 4, 1901.

Although a report of this nature would answer all practical purposes during the progress of a campaign, it is absolutely necessary that each original report, drafted when the troops first take the field, should comprise full information as to all conditions which are likely to have an influence on the health of either officers or men. In succeeding reports, by way of saving unnecessary labour and repetition, these same conditions may be assumed to obtain, in default of information to the contrary. Any departure from the original con-

ditions should be most carefully noted. Brief notes on the weather are also of value, although, of course, detailed meteorological observations are, as a rule, out of the question. The diagnosis 'N.Y.D.,' as it affords no information of value, should as far as possible be avoided.

The original report might comprise the following :

Form of Original Report

Water.—Source and methods of purification.

How distributed after purification.

Food.—If any deficiencies in, or additions to, the authorized field ration.

Shelter.—Whether :

(*a*) Buildings.
(*b*) Tents.
(*c*) Bivouac.

If buildings, their nature, by whom formerly inhabited, if properly ventilated and drained, average number of occupants, structure of roof, walls, etc.

If tents, what design of tent ; if bell-tents, whether single or double fly ; average number of occupants.

If a bivouac, whether the men are using blanket or other shelters.

Refuse Disposal.—Whether burned or buried, and whether, in either case, removed from the vicinity of the troops.

Latrines.—Whether bucket or trench ; disposal of contents of buckets.

Clothing.—If any deficiencies in, or additions to, the authorized field kit.

These headings would appear to comprise all essentials, and, as already stated, they would not again be referred to, except in the case of some change affecting them. Certain definite conditions under which each unit enters on the campaign will now be known, and also, by means of the short tables (of which an example has been given), which should head the report, the general state of health is indicated.

Week by week changes in surroundings will have to be recorded, and from the weekly tables of sickness inferences may be drawn as to the effect of these changes on the well-being of those who have been subjected to them. These reports should form a guide to the sanitary officer as to the matters which more urgently call for his attention. After having carefully investigated the sanitary conditions of any unit concerning which an unsatisfactory report has been received, he could formulate, after consultation with the medical officer in charge of the unit in question, and also with the commanding officer, those measures which, having regard to all the circumstances of the case, have the best chance of being carried into effect with good results.

Should a sanitary defect be discovered in one particular corps, the necessary steps may, if possible, be made a matter of local arrangement, but in cases where the remedy is beyond the powers of individual commanding officers, and where any condition exists which affects, and which is likely to affect, more than one unit, the question should be dealt with at headquarters.

The element of success in these matters must in large measure depend on personal factors; no regulations

in the world will be able to replace ordinary tact and discretion. As a rule, haste to refer sanitary problems to headquarters should be deprecated.

Whatever steps are taken by the sanitary officer, they should be carefully recorded and attached to the weekly report of the medical officer in charge of the unit concerned, and both documents forwarded through the principal medical officer of the division to the principal medical officer of the field force, and duplicates retained by the sanitary officer. These reports should furnish a complete weekly sanitary record of the campaign, and, by contrasting the reports of each division with the returns of sickness furnished from hospitals on the lines of communication and at the base, valuable evidence will be obtained as to those conditions which are directly productive of sickness amongst troops, and of the efficiency of the sanitary measures which have been carried out.

Of course, the weekly report of the medical officer in charge of any given unit may frequently call for no special steps on the part of the sanitary officer. The report can then be forwarded through the usual channel without comment. It should be clearly understood that the weekly table of sickness comprised in the sanitary reports is in no way intended to form part of a statistical return ; it is merely a rough indication of the health of each individual unit, and to obtain its proper significance it must be studied in conjunction with the remarks of the medical officer in charge. The table is useless for statistical purposes, because the diagnoses are in great measure provisional only, it being impossible in the nature of things that they can be otherwise. The real diagnoses are mostly arrived at

when the cases are under treatment in one of the hospitals at the base or on the lines of communication, and it is for this reason that these sanitary reports only attain their full value when contrasted with returns from the hospitals in question, giving information for corresponding periods concerning the particular corps which the reports refer to. Suggested examples of these last-named returns will be given shortly.

To obtain the requisite information from hospitals on the lines of communication or at the base, a list of diseases of the nature already specified might be prepared, and weekly returns of the numbers diagnosed as suffering from these diseases, and these diseases only, each return referring to one unit only, rendered from all the above hospitals, through the principal officers of those divisions to which the sick in question belong, to the principal medical officer of the field force. It should be part of the duty of the divisional sanitary officer to check and compare these returns with those of a similar nature rendered from the various units. The information in question should include not only each existing diagnosis, but the original diagnosis on which each man was admitted from the front. The above proposal would, of course, mean the introduction of a fresh army form; but the inauguration of a new sanitary era in the army must entail labour of a variety of sorts, and among the many returns which will make their appearance with the most unfailing promptitude when we next have occasion to take the field, the one that I have suggested may possibly be allowed a place.

Certain diseases only being included in the latter, the return would be practically of the same nature as the table of diseases comprised in the sanitary reports of

Suggested Form to be rendered Weekly from all Hospitals to Principal Medical Officers of Divisions.

1st York and Lancaster Regiment; May 20 to May 26, 1903.

Companies.	Original Diagnosis.					Present Diagnosis.			
	Enteric Fever.	Dysentery.	Diarrhœa.	S. C. Fever.		Enteric Fever.	Dysentery.	Diarrhœa.	S. C. Fever.
A	2			2	Enteric Fever	4			
		1	2		Dysentery		3		
			3		Diarrhœa			3	
				2	S. C. Fever				2
B	2		3	2	Enteric Fever	7			
		2			Dysentery		2		
			2		Diarrhœa			2	
				3	S. C. Fever				3
C	1		1	3	Enteric Fever	5			
			2		Dysentery		2		
			3		Diarrhœa			3	
				4	S. C. Fever				4
D	3			4	Enteric Fever	7			
			1		Dysentery		1		
			1		Diarrhœa			1	
				1	S. C. Fever				1
E	2		4	2	Enteric Fever	8			
			2		Dysentery		2		
			1		Diarrhœa			1	
				3	S. C. Fever				3
F	3		3	3	Enteric Fever	9			
		2	2		Dysentery		4		
			1		Diarrhœa			1	
				1	S. C. Fever				1
G	2			5	Enteric Fever	7			
			2		Dysentery		2		
			2		Diarrhœa			2	
				2	S. C. Fever				2
H	1		1	4	Enteric Fever	6			
		2			Dysentery		2		
			2		Diarrhœa			2	
				3	S. C. Fever				3
Totals ...	16	7	38	44		53	18	15	19

medical officers in charge of units. The essential is a statement, week by week, of certain diseases occurring in each separate unit. The only remarks required would be a note to the effect if any of the cases contracted their illness at a time that they were absent from their units. Each corps should occupy a separate return, and the cases should be shown by companies. The return refers solely to the number that have been diagnosed during the week, and not to the numbers in hospital, the object of the return being to show the weekly incidence of certain diseases in each respective corps, and not the actual amount of sickness existing at the time.

It does not appear likely that the introduction of a chemical laboratory into the field is likely to be followed by any particular benefit. An incomplete analysis is valueless ; it tells of danger, but cannot tell of safety, and it is impossible to carry out any analysis but an incomplete one under the conditions of field service, and for this reason any such attempt should be abandoned. Water (water being naturally the main subject for analysis) might, for instance, give excellent results when examined chemically, and might at the same time be swarming with an extensive variety of disease-producing germs. These latter could not possibly be detected without recourse to appropriate bacteriological methods, and such methods could not find practical application beyond the walls of a properly equipped laboratory. It is better for a sanitary officer in the field to regard all water as dangerous, or, at any rate, liable to become so ; and, with a liberal provision of the necessary candles, the use of the Berkefeld filter admits of almost universal applicability. Properly equipped laboratories for chemical and bacteriological

work should be established in suitable positions on the lines of communication or at the base, and not, as already stated, in the field. These laboratories should be placed under the charge, but not necessarily under the immediate personal supervision, of a chief sanitary officer. This officer should be attached to the headquarter staff, and being therefore in contact with the chief staff officer and principal medical officer, in a manner analogous to the sanitary officer of a division, he would be available for consultation as to the advisability of sanitary measures affecting either the army as a whole or any individual section of it in particular. It would be his duty to carefully sift the information comprised in the weekly sanitary reports which have been discussed already, and he would by this means be informed as to the sanitary condition of each unit. As already stated, the information contained in the various sanitary reports would afford valuable evidence as to the results of any measures of precaution adopted, and would also form the basis for any action which it might be advisable to take in the future. The method here suggested is, in short, an example of the principle already stated as to the probability of results being gauged in the light of actual experience. As the duties of the chief sanitary officer would necessitate his presence with the headquarter staff, the actual work of the laboratories would be carried on by assistants, but responsibility for the satisfactory performance of this work would lie with the officer in question. As far as possible, he might be allowed a free hand in the choice of the officers who should carry out the various analyses. The results of all laboratory investigation would be forwarded to him,

and would form part of the general sanitary record of the campaign, completing the information contained in the weekly sanitary reports. An illustration may make my meaning clear.

The medical officer in charge of a regiment reports that fifteen cases of diarrhœa accompanied by high temperature have occurred during the week. The cases have occurred in two companies only, and on inquiry it is found that one of these companies has neglected to filter the water for drinking purposes, and that in the other the sterilization of the candles has been omitted. Returns rendered from the lines of communication, in accordance with the form suggested, show that twelve out of the original fifteen cases have been diagnosed enteric fever. The general sanitation of the camp is excellent, and the water-supply, as far as taste, smell, and general appearance goes, is perfectly satisfactory. It is drawn, however, from a stream which flows past a deserted camping-ground about a mile from the source of supply. Bacteriological examination at the laboratory reveals the presence of *B. coli* and *B. enteritidis sporogenes*. *B. typhosus* is not found, but the evidence of fæcal pollution is clear. It is evident that no part of this story can be omitted without destroying its completeness, and the value of such a record cannot be doubted.

The diagnosis of enteric fever being one of such extreme practical importance, it is scarcely too much to suggest that every hospital during a campaign should be provided with the means of carrying out the well-known reaction by agglutination, or, where this is not feasible, by sedimentation. There is no doubt that incalculable harm accrues from mistaken diagnosis, and

the sooner that the nature of doubtful cases can be set at rest, the better for the public service. The extent to which the disease has spread by cases diagnosed as simple continued fever can, of course, never be known, but in the light of present knowledge we can feel confident that this error, which was formerly unavoidable, has been a potent source of widely-spread evil.

The establishment of subordinate assistance would appear to be essential to the success of any scheme of sanitary organization in the field; but if the men engaged in this duty are made supernumerary to established units, the question of their employment will be fraught with some additional administrative labour, and possibly also some administrative difficulties. The duties of a sanitary subordinate would ma nly consist in the supervision of the usual fatigue-parties for camp conservancy, of the cleansing of water-bottles and water-carts, of the filtration or other method of water purification, of the disposal of refuse, and of the construction and inspection of camp latrines. He should also inform the medical officer of the existence of any insanitary condition in the camp. These duties might be carried out by a reliable non-commissioned officer. Whether he should be excused all other duty might be made a matter of local arrangement. Circumstances might arise in which the man would have little or nothing to do, or, on the other hand, the duties might be of an exceptionally arduous nature. The establishment of a fixed rule either way might on the one hand lead to the institution of a licensed idler, and on the other might throw an unreasonable amount of work on the shoulders of a single individual.

Decentralization might here come into force, and it

seems only reasonable that those on the spot will be the best judges as to the amount of work which can be expected under any given circumstances. At any rate, it would be well not to establish the principle of sanitary subordinates being supernumerary to their own establishments until the necessity for such a step was fully proved by experience. The numbers to be employed might also be arranged, as far as possible, according to the exigencies of the case, and not according to a fixed scale. Of course, it may here be argued that commanding officers will not welcome any scheme which calls for the removal of a non-commissioned officer from his ordinary duties. This may be the case, but, as far as personal experience goes, the legend of the obstructive commanding officer is not justified by facts. All men are not alike, but, with few exceptions, I have found that sanitary suggestions made in the field or elsewhere have not only been received with courtesy and attention, but have been faithfully carried out.

To make the scheme of sanitary subordinates successful, the attainment of two distinct objects should be kept in view:

1. The selection of suitable men.
2. The prospect of reward.

The first object might be insured by the establishment of voluntary courses of sanitation for non-commissioned officers and men by medical officers who have a special knowledge of the subject. An examination might be held at the close of the course, and certificates of proficiency given to successful candidates. This certificate should qualify the holder, if a non-commissioned officer at the time, or if subsequently

promoted to such, to fill the post of sanitary subordinate in the field, or elsewhere, if necessary. The second object would be obtained by the establishment of a fixed rate of extra duty pay for men while acting in the above capacity.

The examination would insure the possession of requisite knowledge, and would consequently be a safeguard against the employment of incompetent men; and there is little doubt that the supervision of those sanitary details above referred to by an intelligent subordinate is an arrangement much to be desired. These services in South Africa were often carried out without any regard to the qualifications of the persons to whom their discharge was entrusted. The incident already cited of the soldier applying his mouth to the outlet pipe of a Berkefeld filter is an example of the extreme necessity that exists for selecting trustworthy men for such responsible duties as those in question.

As the course of instruction which has been mentioned above would be voluntary, and as the chance of employment, even if successful at the examination, would be uncertain, it would give additional encouragement to prospective candidates if they were assured that success would be all in their favour as regards employment in civil life. And for this purpose the Local Government Board might be approached with the view of securing the recognition by it of the examination referred to, as qualifying for the post of sanitary inspector in civil life; and, on the other hand, the recognised examinations for the latter purpose, held by the conjoint board, if passed by a soldier, should render him eligible for special sanitary employment in the service. Non-commissioned officers who have carried out sani-

tary duties efficiently should receive a certificate to that effect on their discharge, in order to insure as far as possible that good work done in the army should be productive of reward after the expiration of time with the colours. It seems reasonable to assume that such a proposal as that briefly set forth above would popularize the service by bringing it into contact with the elements of civil life, and it would be an illustration of the principle which is fortunately securing increased recognition, viz., that military service, in lieu of being a disability, is a direct qualification for civil employment.

Whether the scheme which has been proposed would be successful or otherwise cannot be told until it is put to the test of experience; at any rate, it has the merit of what appears to be simplicity, and consequently seems to follow the 'line of the least resistance.' A more elaborate plan may be absolutely necessary, but only the failure of comparatively simple measures can prove this to be the case.

Before dismissing the subject of sanitary organization, it will not be amiss to refer briefly to the subject of auxiliary medical aid in wartime. After considerable experience, I can say with absolute truth that, with scarcely an exception, the civil surgeons with whom I worked in South Africa were men of excellent professional attainments, the best of companions in the field, and blessed with a ready adaptability to novel conditions of life and to the customs of the service. They were, however, through no fault of their own, ignorant of the sanitary requirements of a force in the field, nor did they seem to appreciate the necessity for constant vigilance in the above direction. This defect was, in the natural course of events, only to be expected, as it is clear that an efficient army

medical officer cannot be made without training and experience. I therefore think that when auxiliary aid is called for, preference as to employment should be given to medical officers of volunteers who have passed a qualifying examination for promotion.

The utility of such a measure can scarcely be doubted, as it would insure the employment of officers possessed of knowledge concerning the duties which they would be particularly called upon to perform, besides being a direct encouragement towards the development of a 'National Medical Reserve.' A letter from Brigade-Surgeon Lieutenant-Colonel P. B. Giles, which appeared in the *British Medical Journal* of September 26, 1903, sets forth the legitimate aspirations of volunteer medical officers in this direction, and should be read by all who are interested in making volunteer aid a reality in our scheme of national defence. The question, however, of training of auxiliary forces is too extensive to be fully dealt with here, although doubtless forming a legitimate part of the subject of military sanitary organization on active service.

Although this matter is one on which national welfare largely depends, it has not received the degree of attention from the medical profession which its importance certainly demands. For this reason volunteer medical officers should be expected to display that practical knowledge which is essential if they are to carry out efficiently their duties as servants of the State, and the services of officers deficient in this knowledge should be dispensed with. By making volunteer aid a reality to which grave responsibilities are attached we may hope that a more accurate idea of our work and of its requirements than that now obtaining will gradually spread itself through the civil ranks of the profession. As an

example of the lack of knowledge which prevails in this particular direction, I may cite the case of an eminent London surgeon, who, after a few months spent in South Africa in the earlier stages of the war, embodied his views on the subject of medical aid in war-time in the form of a signed communication to a leading medical journal. This gentleman, in the course of his remarks, was good enough to observe that the medical officers of the army were, in his opinion, men of common-sense, and generally adapted for the discharge of their particular functions. Unfortunately, this compliment (which was naturally most gratifying to our self-esteem) was somewhat discounted in value by evidence of a certain confusion in the mind of the talented author as to the nature of the duties to which he refers. He recommends, for instance, that a preliminary course of study should be undergone at the base hospitals by the medical officers of the regular service under civilian surgeons, in order that the former may qualify themselves for the work they will be called upon to perform at the front. What professional duties the officers were previously qualified to perform is left in doubt.

If there is one particular subject in which our civilian colleagues are not competent to instruct us, it is certainly the nature of our duties in the field, and the above proposal is clear proof that the author of this communication was not aware of what these duties actually comprise. There is no intention here to comment with any acrimony on the above suggestion, the latter having been cited with the sole object of illustrating previous remarks as to the existence of a widely-spread ignorance of what is without doubt an

important factor in the continuance of our national existence.

The proceedings of a meeting, in March, 1903, of the members of the Association of Military Surgeons of the United States is of great interest as evidence of the fact that the Americans are fully alive to the necessity for disseminating a common-sense knowledge of sanitary principles as applied to conditions of active service. An extract from the remarks of one of the speakers (Major Ames, N.S.V.) is worth quoting verbatim; it is reported as follows: 'I remember a very dismal experience in the campaign of the Gulf, 1863. The regiment marched into a field to camp for the night in two inches of water, and the men had to get along as best they could. They had to stay there two or three days. We had some capital surgeons; they embraced good, loyal men, whose names you would recall. But there was just one man in that outfit who knew enough to drain that field. He had the practical sagacity and required knowledge to put a lot of men at work to rig up an Egyptian pump and drain that field, and in less than eight hours he had that field dry, and was throwing up a trench around it. That is the sort of practical sagacity it seems to me we most need in times of emergency for the welfare of an army, quite as much as whether or not this, that, or the other bacillus or some unknown cause is at the bottom.'

These remarks embody an important truth illustrated and expressed in vigorous and common-sense language. In South Africa we had with us eminent medical men, well deserving of those terms of respect in which Major Ames alludes to certain of his own countrymen, but, like the latter, devoid of that practical know-

ledge which is essential for the sanitary organization of an army in the field, and consequently to the welfare of the public service. Whether this defect will ever be remedied by organizing and training that civil medical aid which may be necessary in our next war is a question which a beneficent War Office alone can decide.

CHAPTER VI

GENERAL CONCLUSIONS AND RECAPITULATION

1. THAT, apart altogether from endemic causes, certain conditions attendant on field service are potent factors in the production of disease.

The extreme importance, as evidenced in the medical press, attached to the purification of water on service is proof of a tendency in the minds of many to regard certain diseases which are common in the field as being due to causes which exist altogether independently of the presence of troops. There is here no intention of minimizing the hygienic value of a pure water-supply to troops on service, but only an attempt to point out, as far as possible, that such a measure will by no means prove an absolute protection against those diseases which it is designed to eliminate.

Examples have already been given of enteric fever and dysentery occurring among bodies of troops stationed in previously healthy localities, but, in view of the practical importance of the question, further illustrations in this connection may not be out of place.

The case of the Boer prisoners at St. Helena is an excellent example of the production of sickness in a community where endemic causes could be absolutely

eliminated. It is, of course, true that these men were not engaged in operations in the field, but the conditions under which they were placed bore a sufficient resemblance to circumstances common on active service to justify the illustration in question for present purposes. I must admit that I have no personal know-

Fig. 26.—*Camp of Boer Prisoners at Broad Bottom Field, St. Helena.*

(Photograph by Mr. A. L. Innes, St. Helena.)

ledge of the administration of the camps in which the prisoners were confined, but I have, on the other hand, a fairly intimate acquaintance with the island of St. Helena, including the localities at present in question. During a residence of five years in this colony I was only made aware of the existence of two cases of enteric fever, both of which occurred in Jamestown, and I have every

reason for believing that the country districts were absolutely free from the disease. The positions on which the Boers were camped were situated in the healthiest and most elevated parts of the island, and possessed a natural water-supply of absolute purity.

One of the camping-grounds, known locally as Deadwood Plain, had for years been occupied at intervals by small bodies of troops. The area of land being extensive, and, as just stated, the number of occupants being limited, certain disease-producing factors which have already been dwelt on, as regards camps, could have no chance of coming into play. Deadwood was, in fact, regarded as an ideal sanatorium for troops during certain months of the year, and the above opinion was amply justified by prolonged experience. That the Boers suffered severely from sickness—notably enteric —during their residence in the locality in question is now a matter of common knowledge. The second camping-ground was situated on a grassy slope known as Broad Bottom Field, and, as regards health, left nothing to be desired. At the latter locality, however, enteric fever also broke out in an epidemic form. Lieutenant-Colonel G. C. D. Mosse, R.A.M.C., P.M.O. of the colony in question during the war, informs me that enteric fever was without doubt imported by every batch of prisoners. I may here take the opportunity of quoting (with permission) from a letter which Lieutenant-Colonel Mosse was kind enough to write to me on this subject : 'I attribute the outbreak to the clouds of dust (contaminated) which blew over the camps. Flies also appeared in myriads, and I attribute the spread of the disease chiefly to dust and flies.' It seems fairly reasonable to assume that

the vitality of the bacillus in the soil (from which the dust came) was maintained by organic pabulum, the result of the prolonged occupation of these localities by large bodies of men.*

As regards experiences on the Nile, already alluded to, I have never succeeded in obtaining evidence that

Fig. 27.—General View of Camp at Olivier's Hoek.

The tents covered an extensive area, so that the evils of concentration were largely avoided. The camp was singularly healthy, although enteric fever ultimately appeared, but in a very mild form.

(Photograph by Captain C. Abbot Anderson, the Manchester Regiment.)

enteric fever existed endemically in the native peasantry. To state that the natives were insusceptible to infection, and that therefore their freedom from the disease

* The conditions of life amongst these men, although the latter were not on service, must have approximated closely to those of the soldier in the field, but in standing camp.

was no evidence of the absence of its ultimate cause—viz., the *Bacillus typhosus*—appears to be an attempt to establish an otherwise unsupported assertion by means of an entirely gratuitous assumption—an assumption, also, which is absolutely disproved by the fact that the native population of the towns (where the malady is without doubt endemic) suffered severely. In the Annual Report of Surgeon-Major Beattie, Medical Officer in charge of the Citadel Hospital, Cairo, for 1884, we read as follows: 'The insanitary conditions of Cairo are quite sufficient to account for the presence of enteric fever, which is perhaps the chief disease in the native population' (Army Medical Reports for 1884).

That the rural native population remained healthy at a time that epidemic sickness was working havoc amongst troops is a fact which may be explained by differences between the European and Arab modes of life, and will be considered further later on.

2. That among disease-producing factors soil pollution occupies a prominent place.

During the recent campaign it was constantly noticed that sickness largely vanished on trek, but that a few days' residence in standing camp was invariably accompanied by a lower standard of health. Towards the close of the war the good effects of trekking were far less noticeable than when we first took the field. A suggested explanation of this fact has already been given. It is scarcely necessary to add that the greater the concentration of troops, the more the effects of soil pollution became evident.

In addition to the examples already given, the results of soil pollution are well set forth in the report of Brigade-Surgeon Ramsbotham, in charge of Ramleh

Hospital, Alexandria, 1884 (Army Medical Reports, 1884). Brigade-Surgeon Ramsbotham writes as follows: 'All statistical evidence proves that the prevalence of enteric fever stands in close relation to the imperfection with which sewage matters are removed, and when we consider the general absence of underground drainage, and the prevalence of cesspits everywhere beneath the houses in this country, it is not difficult to understand how, favoured by warmth, stagnation, and seclusion from open-air, fermentation of fæcal matter ensues, and poisonous effluvia becomes generated. Out of sixty-five cases in Alexandria district, fifty came from Ramleh Barracks—the King's Royal Rifles stationed there from May 20 to August 13 furnished thirty-eight cases, and twelve cases occurred since then in the Yorkshire Regiment. This localization seems to indicate that it is not to the water-supply of the town that we must look for the causation of the disease, but to other causes, and the conclusion that is arrived at is, that the chief cause to be assigned for the prevalence of fever in those barracks must be looked for in the saturation of the soil underneath them by sewage matter in past years, caused by the cesspits and drains being built without inverts, the bottoms being thus left open, allowing the sewage to percolate into the soil.'

Certain of the above remarks may appear somewhat crude in the light of latter-day science, but this fact does not detract from their practical value.

The relationship between soil humidity and the prevalence of enteric and other continued fever is, in this connection, most significant. For instance, in another part of the Army Medical Reports for the above year—viz., 1884—we find it stated by Surgeon-

Major Beattie that 'the increase in continued fevers in June, coincident with the rise of the Nile, and their decrease in October, was, as usual, well marked.' It was also officially reported that 'other continued fevers were most prevalent in the months from June to October inclusive, after which they are greatly reduced in frequency, and in January, February, and March the cases occurring were very few.' In view of the above, it seems fairly reasonable to regard the increase of humidity caused by the rise of the Nile to have been the means of starting the activity of dormant forms of microbial life already existing in the soil.

As already stated as regards Natal, there is a marked connection between the height of the rainfall and the incidence of enteric fever.

The fact that during the Nile campaign the rural population of the river provinces was remarkably free from both enteric fever and dysentery furnishes another argument in favour of a causative relationship between pollution of the soil and the diseases in question. For countless generations the fellaheen have regarded the Nile as the natural receptacle for refuse of all sorts. At sunset the peasant* proceeds to the bank of the river, where he attends to both his physical and spiritual needs by defæcating at the brink of the stream, and, after the necessary ablutions, turning his face towards Mecca, and calling on the name of Allah and that of his prophet. This regular procedure almost suggests the idea that the devout Mohammedan returns thanks at a singularly appropriate time for the means provided for

* The habits of the Egyptian soldier were different from those of the peasant, as the former defæcated anywhere, including camp, in the most unconcerned manner.

the ready and rapid removal of deleterious material. Nor would his thanks be offered without good reason, for not only does the river carry away from his habitations matter the presence of which is inconsistent with health or comfort, but, when the stream overflows its banks, the same material, in a somewhat altered form, fertilizes the fields which yield him his means of life, and thus takes its place in the eternal cycle of natural utility.

Not only does the excreta, but the general refuse of the villages, find its way to the river, and in this fact, coupled with the circumstance that the agricultural inhabitants occupied an extensive area in proportion to their numbers, we find that certain disease-producing agencies which affected the soldier in camp were absent from the primitive mode of life common to the rural districts of the country. It is very certain that it was utterly impossible for the military authorities to legislate for habits which had been handed down to the Egyptian peasant for countless centuries, and the fact that we abstained from using the river as a sewer was not in the least likely to have any practical result as regards its purity. A population of many thousands were daily putting the stream to the above purpose, and that a comparatively insignificant number of men refrained from doing so was a circumstance which could not possibly affect anyone but themselves. Had we followed the example of our primitive neighbours, we should, at least, have subjected our refuse to those purifying agencies present in all rivers, and have also added to the general fertilizing powers of the stream ; instead of which we adopted a course which resulted in the wholesale production of discomfort,

disease, and death. I should make it clear that I am not attempting to advocate the indiscriminate pollution of rivers, and that my statements only refer to conditions of life in Egypt such as I saw nearly twenty years ago. One fact here stands out prominently—a fact which meets with everyday recognition, but which appears to be occasionally forgotten on service—viz., that the removal of organic refuse from human habitations is a necessity, as its retention in their neighbourhood is incompatible with the continuance of healthy existence.

The influence, in this connection, of the concentration of troops is one of the very highest importance. The military aspect of the question is one with which I am naturally not prepared to deal, but at the same time there appears to be no adequate reason why, particularly in the light of recent experiences in South Africa, it should not be officially recognised that the concentration of troops is to be avoided, as far as is consistent with tactical or other considerations of paramount importance.

The danger of concentration is intensified when field hospitals are pitched in the neighbourhood of fighting units. It may also be noted, as indicated on accompanying plan, that the area allotted to the former is none too extensive.

The broad principle of allowing the camps the fullest space which is consistent with military requirements is one which admits of very general application, and, once its importance is fully grasped, the result can scarcely fail to be beneficial.

One of the most concentrated camps that I have ever seen was at Springfield Bridge, during the march to the

Tugela, previous to the Battle of Spion Kop. The halt was only for one night, but a few days later I had a striking object-lesson in the results which flow from

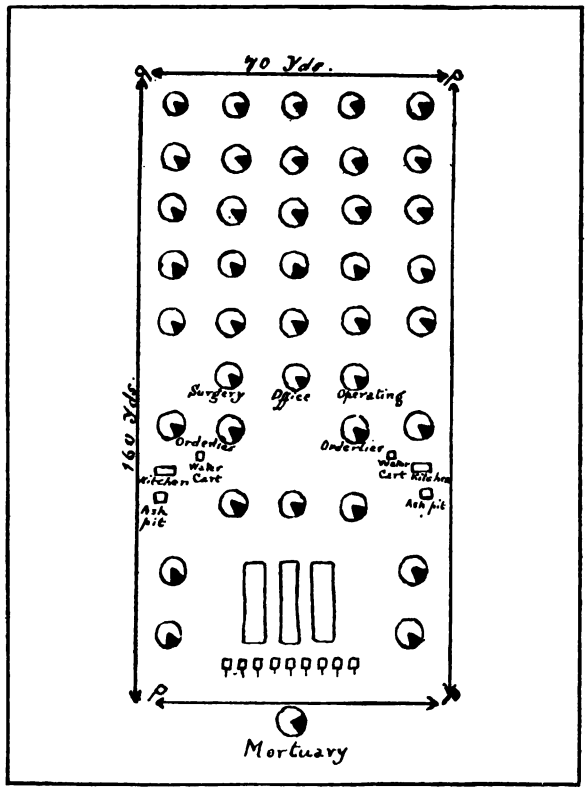

Fig. 28.—*Plan of Field Hospital.*

even such a short occupation as the above of a comparatively restricted area by a large body of men.

Two companies of the Middlesex Regiment were left as a guard to the bridge, as the destruction of the latter

would have prevented the arrival of supplies at the front, besides seriously impeding our retreat to the railway. These two companies were left without a medical officer, and it became my duty to ride back daily from my own unit, which was at the time some miles in advance, and see such men as wished to report sick. The ground which had been occupied by the advancing troops was almost devoid of vegetation, forming a striking contrast to the surrounding veldt, and was literally covered with swarms of flies.

Fever of an indefinite nature was prevalent among the men, and many of them were transferred by my direction to the hospital at Frere. How many developed enteric fever I do not know. The conditions of health contrasted most unfavourably with those of the units which had advanced, and which were now spread out over a fairly extensive area. Taking all the facts into consideration, it appears fairly evident that the sickness in the two companies was the direct result of the polluted soil, and which latter was, in turn, the result of the occupation by a large body of men of a camping-ground of comparatively limited dimensions.

The better conditions of health prevailing among the men occupying the hills to the north of Spearman's Plain, as contrasted with the rest of the Ladysmith Relief Column, has already been noticed. It can scarcely be doubted that this difference was due to the fact that the occupants of the plain were concentrated to an extent which was far from obtaining in the case of the troops holding the hills.

3. That, although the existence of water-borne enteric fever is beyond doubt, other factors—notably

soil pollution—are of as powerful a nature as the first named in a like direction.

The effect of soil pollution in this connection has been so fully dealt with that it needs no further mention here.

Flies and dust are also well-known agencies. During the winter and spring of 1900, while at Ladysmith and Chieveley, our food was literally swarming with flies, including the bottle-green variety, the presence of which is so common a feature in camp latrines. In the field hospitals muslin covers were largely used for the protection of food, but the utility of this measure was only of a partial nature, as the moment the muslin was removed the food was covered with these disgusting insects. That dust is a means of spreading enteric fever is a matter which need excite no surprise in a community where all sorts of filth are thrown recklessly on to the surface of the soil; and the South African Kaffir has no scruples, unless carefully watched, in disposing of the contents of latrine-buckets in a manner more consistent with his personal convenience than with the requirements of health. There is little room for doubt that dried excreta are disseminated constantly in South African towns by means of the frequent dust storms which occur in that country.

4. That the best means of water purification are not known with certainty.

Pending more perfect information concerning the practical value of recent proposals in connection with a supply of 'safe water' for troops, it should be an essential of field sanitation that the water-carts used for the carriage of water from the source of supply to the camp should be kept absolutely distinct from those from which the drinking-water is drawn. On

arrival in camp, the water should be passed through a Berkefeld filter into a second water-cart, and from the latter the men could draw their supplies direct. Great care should, as already indicated, be taken to prevent the entrance of any extraneous matter, an accident which might easily result from a badly-fitting lid. It is a pity that the tanks on the carts are not in all cases made circular, and capable of receiving a rotatory movement, in order to facilitate cleaning. Iron treated by Barff's process would be an excellent material from which to construct the former, and would be a distinct improvement on galvanised iron. For obvious reasons, the wooden water-cart should not be employed when the modern one can by any possibility be obtained. It would be a great advantage if all carts were provided underneath with an additional tap, to insure complete emptying. The present taps are not absolutely flush with the bottom of the tank.

In the opinion of certain medical officers of the United States Army, the Berkefeld filter is, as already stated, not free from very grave objections.

Practical tests of the Waterhouse-Forbes water-sterilizer, will, it is hoped, be carried out in our army.

Purification of water by chemicals is scarcely likely to be successful in the field. The measure in question means an additional strain on transport, and, in fact, on administration generally, and the soldier cannot be trusted to apply such methods himself.

Whether the Berkefeld filter is the best means for the purification of water on field service is far from certain ; at any rate, it is the best means that we know

of at present, although there is good evidence that the apparatus named above (*i.e.*, Waterhouse-Forbes sterilizer) is in many respects superior to it.

5. That, as so many cases of so-called simple continued fever are undoubtedly enteric fever, and as these unrecognised cases are active agents in the spread of the latter disease, means for carrying out the serum diagnosis should be given as wide a field as possible of general applicability.

Unfortunately, the serum reaction is not obtained at the beginning of the attack, usually not before the sixth day, so that, even under favourable conditions, the diagnosis must for a time remain doubtful. When, however, the fact is considered that men on service have, owing to no fault whatever of the medical attendants, passed through the whole course of the disease undiagnosed, and have, without doubt, been the means of widely disseminating infection amongst the troops, we should welcome any means, although possibly imperfect, of ridding the public service of a serious source of danger, apart altogether from the manifest advantages accruing to individuals from a procedure with which personal safety is so closely associated. Although the method in question should certainly come as far as possible into general use, I do not think the means for carrying it out should form part of the armamentarium of field hospitals. These establishments belong essentially to the fighting force, and to retain a man in the immediate proximity of effective troops with the object of ascertaining whether or not he is suffering from such a disease as enteric fever is certainly not consistent with the interests of military sanitation.

6. That the prevention of disease in an army in the

field resolves itself largely into the question of the disposal of organic refuse.

Little can be here added to this part of the subject, which has already been considered at some length. One great difficulty in the removal of refuse from camps is the absence of necessary labour. Burning is, of course, the safest, and therefore the most satisfactory, means of refuse disposal, but, unfortunately, it is a matter of difficulty to carry it out in the absence of special destructors. Detailed descriptions of various apparatus of the above nature will be found in Captain Munson's admirable work on 'Military Hygiene.' To supply every isolated unit with special means of refuse disposal is scarcely necessary, but it would certainly be a step in the right direction if portable destructors were, within reasonable limits, supplied to every standing camp, particularly in tropical countries.

7. That the spread of epidemic sickness in the field is largely the result of the presence in field hospitals of patients suffering from forms of communicable disease.

The difficulties in the way of carrying out isolation at the front need scarcely be further insisted on. Neither the accommodation nor the administration are adapted for any such purpose.

A large percentage of the patients in field hospitals are admitted as suffering from that group of febrile diseases classed under the general heading of 'Simple Continued Fever,' and that simple continued fever is frequently enteric is generally now admitted. These men find themselves in the immediate proximity of others in the restricted area of a bell-tent, where, as constant supervision is impossible, they enjoy what is practically a community of blankets and food utensils.

Unless rigorous measures are adopted (which is not always possible), urinary excreta speedily pollute the soil in the vicinity of the tents, clothing and blankets become infected with the alvine discharges of the more serious cases, while no known precaution will prevent the swarms of flies attracted to the spot in search of food from acting as carriers of disease of a deadly description. The above remarks, of course, apply equally to enteric fever, diagnosed as such, or, in fact, speaking generally, to all forms of communicable disease.

8. That, with a few common-sense exceptions, the excreta of all patients in field hospitals should be sterilized.

The necessity for this step scarcely needs further discussion except to reiterate the extreme importance of carrying out this measure (as far as it can be done when working with mobile units) as regards all men suffering from febrile symptoms, particularly when accompanied with intestinal derangements. The importance of undetected cases of enteric can scarcely be exaggerated, and it is, therefore, the surest road to safety to regard all such cases of the nature referred to as calling absolutely for the completest measures of disinfection which are found to be possible.

9. That, as far as is consistent with military exigencies, autonomy should be granted to the medical service of the army as regards sick transport.

To have made adequate preparations for the sickness which prevailed in our army in South Africa was certainly beyond the powers of all human forethought; but now that the campaign is over, it is quite in accordance with purposes of public utility to endeavour to trace a causal relationship between our administration

and the diseases which dogged the footsteps of the troops.

To remove the sick from the healthy is a principle of universal application in civilized nations, and its necessity is not a matter which admits of discussion, as it is evidently essential for the welfare and for the healthy perpetuation of communities of all sorts. For reasons which have been already stated, it was at times found impossible, during recent events in South Africa, to give adequate effect to the above principle.

During the hostilities that occurred on the Tugela at the close of January and beginning of February, 1900, the troops of the Ladysmith Relief Column were approximately 40 or more miles from a line of railway, there was nothing in the nature of a road, the tracks of the waggons only marking the way, and there were at least three drifts of a difficult nature to be negotiated. Under the above circumstances it is evident that the strain on the transport would, of necessity, be considerable, and the Army Service Corps would not be likely to furnish waggons and oxen except when urgently required for purposes of supply. Yet, in great measure, these were the means which had to be relied on for the removal of sick and wounded.

With regard to the latter, a few days more or less at the front would have made no particular difference, as the arrangements for their accommodation, considering the circumstances of the case, could scarcely have been improved.

The sick, however, presented a problem of a more serious nature, as their retention in the neighbourhood of the effective force could scarcely fail to be followed

by consequences reaching far beyond the individuals themselves.

In civil life sanitary authorities naturally administer the methods employed for the removal of infectious cases to the hospitals. Being responsible for the maintenance of the public health, they control all means for discharging their duties as public servants. There seems no apparent reason why this principle should not be extended to the medical service of the army, a service which carries out in military life duties analogous to those accepted by sanitary authorities as regards the civil population. It is perfectly true that ambulance waggons are always at the disposal of the medical authorities, if not actually under their control, but this form of transport is not sufficient to meet the requirements of the field. In South Africa the transport commonly used in the country was constantly in requisition for a variety of purposes besides the removal of sick, and it therefore could not always be spared for the last-named purpose. Had the medical department enjoyed autonomy in this particular matter, there is little doubt that the public service would have gained a most material benefit.

10. That sanitary records on the lines indicated should form the basis for future action.

This is simply an application of the principle of accepting experience as the natural guide of action. This principle has already been sufficiently dwelt on.

11. That the study of prevention of disease on service consists, in the main, of an intelligent comprehension of the various disease-producing factors which affect the soldier in the field.

Lastly, that although official sanitary regulations

are, without doubt, not only of high value, but also absolutely necessary for the maintenance of efficiency, the actual working-out of details under the varying conditions of active service must be left to common-sense, an essential part of the mental equipment of the Army Medical Officer.

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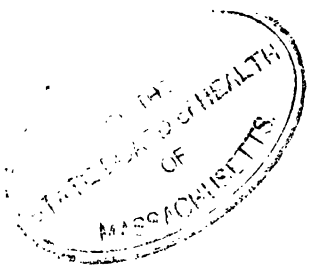

THE END

BAILLIÈRE, TINDALL AND COX, 8, HENRIETTA STREET, COVENT GARDEN